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THE SPECIAL FIELD OF NEUROLOGICAL SURGERY: FIVE YEARS LATER.[1]

By HARVEY CUSHING, M. D.,

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The supreme misfortune is when theory outstrips performance.
—*Leonardo.*

Five years ago, at the instigation of my friend Dr. Crile, an address entitled "The Special Field of Neurological Surgery"[2] was read before the Cleveland Academy of Medicine, of which he was then the presiding officer. Advantage was taken of the occasion to make a brief explanation—to offer an *apologia,* as it were—for the contemplated restriction of my professional activities to what appeared at the time a narrow and unpromising field of surgical endeavor. Bearing this in remembrance, I have gladly accepted Dr. Chamberlain's invitation to address you again, for it seems a fitting opportunity to contrast with its former barrenness the relative fertility now shown in this small acreage, where seeds, though often planted in the past, have borne scant harvest from lack of intensive cultivation.

The reasons for this change involve certain principles of concentrated, specialized or intensive surgery to which I wish to allude at the outset. Among many of my surgical friends there exists, I am aware, a general tendency to disparage specialization; to minimize such services as have been rendered to the science as well as to the art of medicine by those who have particularized in gynecology, orthopædics, or genito-urinary surgery—to give some specific examples—or indeed in further subdivisions of these special fields. Perhaps we all should be "general surgeons," fitted by our comprehensive training to undertake anything in the way of an operation which the human body demands. But unfortunately this is impossible and such an attitude often entails consequences which are not only disastrous to the patient, but which also boomerang back unerringly to the ill repute of surgery, in the folds of whose mantle many overventuresome operators envelop themselves.

Though an occasional technical stride may be made through the operative courage of a McDowell, the permanent advances are far more often the result of patient laboratory investigations; such, for example, as led Hunter to ligation for aneurism, Bigelow to reduction at the hip, Billroth to intestinal anastomosis, Horsley to the first removal of a spinal cord tumor, Carrel to a perfected blood-vessel suture. The real leaders of to-day in surgery owe their place not to any special brilliancy in operative manipulations, but to their laborious experimental investigations of certain problems of disease, whereby has been disclosed a rational mechanical basis for a surgical therapy which can then be safely and successfully adapted by their many followers. Lasting contributions in surgery, as in any other field, are certain to come only as the result of such concentration. Without it, if we do not actually go backward or stand still, the advance at best is haphazard and spasmodic.

To the contributions of one group of intensive workers we

[1] An address, fragments of which were made to serve double duty before the alumni of the Lakeside Hospital, in Cleveland, January, 1910, and before the Cleveland Academy of Medicine, October, 1910. Printed simultaneously in the Cleveland Medical Journal.

[2] The Cleveland Med. Jour., January, 1905, and The Johns Hopkins Hosp. Bull., March, 1905.

owe the fact that extreme bony deformities are now a rarity, and that club-footed adults and the pitiful prototypes of Punch and Judy are no longer seen on every hand. The labors of others have made possible the amelioration and in many cases the certain cure of one of the most trying afflictions of advancing age—prostatic hypertrophy. To similar specialized investigations we owe nearly all of the striking and permanent advances which have come to be applied to the treatment of disease in their special fields by gynecologist, otologist, laryngologist, ophthalmologist, proctologist and the rest.[3]

Nor are we by any means at the end of specialization; for this tendency is merely a sign of the inevitable differentiation of work necessitated by advancing knowledge and the introduction of new methods. Who would have ventured, twenty years ago, to predict a special surgery of the blood vessels or of the thorax sufficient to engross the exclusive attention of productive workers. Forms of pressure apparatus promise to revolutionize the treatment of many intrathoracic lesions formerly inaccessible, and meanwhile the Roentgen ray and stereoscopic plates are threatening to supplant the stethoscope of Laennec in the early recognition of diseased foci, as they have already supplanted crepitation in the diagnosis of fractures. Meltzer's experiments even suggest a possible intratracheal treatment of lobar pneumonia. Then close on the heels of the successful suturing of the peripheral vessels doubtless will come a particular surgery of the heart and aorta: and though it is a long cry from John Hunter's experiments with the cock's comb to Carrel's visceral transplantations, it requires no wild imaginings to foresee the day of transplanted organs and members. It is obvious that clinical specialization in itself is no longer sufficient for the advances that are in the making; it must go hand in hand with laboratory experiences, as has been true of the work of Kocher, Halsted, Horsley, Crile, and other notable contemporary investigators.

[3] There are large opportunities in our modern hospitals, among other surgical specialties, for a skilled proctologist who will investigate anew the common diseases of the lower bowel and finally contribute scientific procedures to take the place of our rule of thumb methods now applied to them. Important as its normal function is to the comfort and activity of mankind, the lower bowel has been abandoned as an object of special investigation for newer and less distasteful fields. Even the old saying that the chief reason for a surgical consultation is to have a rectal examination made no longer applies. Yet proctologists were among the first specialists. John Arderne, "master surgeon of the long robe," in the 14th century wrote an elaborate and much reprinted treatise on the homely subject of Fistula in Ano—a malady thought to be incurable before his time. In the treatment also he became expert, owing not only to his zeal, but also to unusual opportunity, for it is presumable that the long hours in the saddle of the heavily armored knights of his time, with the exposure and fatigue incident to the Hundred Years' War, was a frequent cause of this particular affliction. Again, four centuries later, though cures had become not infrequent, no less a one than Percival Pott deigned to write a special monograph, which passed into many editions, on this, surgically speaking, still important theme.

But there is another element in addition to intensive effort which is essential to any notable advance in surgery—namely, opportunity, not only for the experimental or laboratory investigations, but for the clinical application of their results. Indeed, without it, well-directed efforts may be impossible. Unhappily it is common to see abundant opportunity lead to no concentration of work; but fortunately it is only rarely that special investigations go unrewarded by an opportunity to put the results into practice. This is true in spite of the widespread opposition to specialization on the part not only of individuals, but also of many institutions.[4] Too often, however, even when opportunity exists there may be wanting an inclination for research, which requires not only imagination but training; or what is too common, the inclination may be there and yet be blanketed by a deadly routine of institutional responsibilities. It is unquestionably essential to the productiveness of an investigator that he sacrifice all unrelated work to the immediate problem or problems at hand—and whether this sacrifice be justifiably continued for months or years or for the remainder of a professional lifetime, depends on the nature of the investigation and the character of the returns. Naturally a certain anxiety concerning livelihood lurks in the minds of all who are wage-earners rather than salaried individuals lest those dependent on us suffer through this sacrifice. But all such obstacles will never effectually deter from research one who has a natural bent in this direction, and the anxiety is assuredly a groundless one so far at least as surgery is concerned, for in this branch of medicine there are almost certain rewards for the contributor to knowledge.

But it is less of individual skill in this or that direction that I speak, for this is largely built upon experience: it is rather of the pathfinder's tendencies to enter new fields. One cannot blaze a new trail and continue on the old path at the same time: this is too much of a straddle for present-day surgery. The surgeon skilled in work on the alimentary canal and its appendages may set a broken leg abominably: and the orthopædist would often make a relatively poor showing in the treatment of a pyloric stricture. Nor should either attempt to do what he has either forgotten or has never learned.

Our rapid approach to a new order of things in medicine has been pointed out by many, and the fact must be faced, particularly by the present general surgeon and general practitioner, whose daily wage is noticeably shrinking through prevention of disease by school inspections, by boards of health, by campaigns for pure water and milk and against the "white" and "black" plagues, by district nursing, social service organizations and State hospitals for contagious and incurable diseases. The community is awaking not only to the better care for the sick, afforded by large and well-manned institutions, but to the possibilities of preventive medicine,

[4] The large general hospitals have been notably loath to recognize specialties, many of which have been forced to establish themselves at the outset in small institutions erected for the purpose.

and doubtless the great physicians of the future will more and more devote their energies to preventing disease in bulk rather than in treating it in the individual. In China the physician is paid only so long as his patients remain well, and on this basis modern methods of prevention insisted upon by a wise Government will some day enable him to double his livelihood. In this country, where doctors are paid, if at all, only for their attendance on the individual while ill, these methods, already being introduced, are having the contrary result.

But these coming changes are more apparent in their relation to the physician's than to the surgeon's activities, except in so far as the community is learning that surgical operations are necessarily safer in large hospitals, where the majority of them may come to be done in some future and more communistic time by salaried and possibly State-paid individuals who are specialists in their particular lines. For the performance of surgery is elaborate, expensive and time-consuming, and its more difficult forms, such as those which I am to discuss, must be carried out in familiar surroundings with a more or less fixed and permanent staff, so that the machine runs without hitch; otherwise safety will be sacrificed. The community deserves and, when enlightened, will demand better service than the old "cut and run" methods which still pervail in many, even of our larger, institutions.

The ideal surgical hospital would be one whose senior appointees after a broad general surgical training would be encouraged by continuous services to concentrate their work on special subjects—as many subjects as there are men who may be qualified as pathfinders. I realize, of course, that such positions cannot be created outright and men found to fit into them. Rather it will happen that positions must be built around such individuals as are available and must grow in accordance with the individual's capabilities. A junior staff in the meantime would carry on the general routine work, any subdivision of which, it is true, may become special to-morrow through some unexpected discovery, and again at some later day lapse back once more into the general mill, but always, it is to be hoped, on a higher plane.

A new department may any day be justified by an unexpected discovery which at the time may seem trifling. Chamberlen's forceps revolutionized obstetrics, the Wagner bone-flap made a new surgery of the brain, an "optical toy" of Helmholtz created ophthalmoscopy, Babington's mirror brought into being laryngoscopy, and otology received its impulse from the discovery of Eustachian catheterization. Thus not only may a demand for a new subdivision crop up at any moment, but the work of any established department may have to be entirely remodeled through a chance discovery—a new instrument of precision, a tissue stain, a serum reaction, a principle of vaccination. And the more of these discoveries there are, the more rapidly will the unfortunate and absurd segregation into two separate bodies, physicians and surgeons, be broken down. As simple a thing as the Pravaz syringe has made a surgeon of every physician who does a lumbar puncture, who aspirates the chest, or, indeed, gives a hypodermic injection: and were it not for this hollow surgical needle could we take a blood culture or administer Flexner's serum in meningitis? Physician or surgeon—it is really but a difference in the degree of surgical or medicinal dosage.[5]

But we continue to speak of "internal medicine" as though this were in contrast to "external medicine," or surgery. The surgeon before Lister almost of necessity was an "externist," but to-day the scalpel is the most satisfactory medicine for gallstones, for an inflamed appendix, a pyloric stenosis and much else internal. The tables are reversed, and the abdominal surgeon, strictly speaking, has become the "internist." Needless to say, then, he must share with the physician the same underlying knowledge of the function of the organs he treats and of the diseases to which they are liable, and must possess an equal diagnostic facility—indeed, he is likely to excel in this respect unless the physician makes a practice of frequenting the operating room.

This transformation of surgery from practices based almost wholly on an anatomical knowledge of the surface and extremities of the body, to ones based on the physiological activity of the viscera, has come rapidly, and physician and patient have both at times been hurt in the process. But it must be said of the physicians that their reluctance or hesitation to accept surgery as an oft-needed form of therapy, not only for the intra-abdominal maladies surrendered in the past, but for many intrathoracic and intracranial conditions of the present, has more often come through fear of surgical foolhardiness and its consequences than from jealousy of the surgeon's trade and ignorance of its possibilities in cautious and skilled hands. It is not to be questioned that the greatest asset of the best physicians is a full knowledge of the accomplishments of mechanical and operative therapeutics. The patients' risks are about equal between the physician who knows nothing of surgery and the surgeon who possesses no alternative but the knife.

It is all a matter of taste, what one shall do with himself in the wide reaches of Medicine. As John Locke puts it, "The inclination of the mind is as the palate to the stomach, that seldom digests well, that nauseates the palate, and is not recommended by it." So the turn of mind which breeds inclination for handicraft draws one into the manual work which repels another, but for all of us the fundamental need is a basic familiarity with the principles of disease, surmounted by such superstructures of special knowledge of a few particular maladies and their treatment as we are mentally and manually capable of imposing upon it. Thus any manipulative speciality may be safely superimposed on the secure foundations of general surgery and may exist with no loss of the broad conceptions of disease essential to its permanence: without such a foundation the specialty soon

[5] There is, of course, a certain danger in the too literal acceptance of Billroth's epigram, "Die innere Medizin müsse mehr chirurgisch werden," with which I closed my former paper. Surgery must beware lest it topple from its standard of general medicine. Surgeon and physician, standing on the same basis of common knowledge, differ only in the forms of therapy they are fitted by training or by inclination to employ.

becomes top-heavy, and the increasing numbers who are boosted by short cuts to the top increase its instability, until a danger sign is necessary lest the structure actually tumble to the ground and harm Medicine through its fall.

The present tendencies in gynecology serve as a familiar illustration. As the pioneers in this specialty pass, the feeling grows among their successors that the gynecological field has been worked out; and, widening the boundaries of their claim through this misapprehension, they unconsciously become again general surgeons—many of them, alas, with their general surgical knowledge built upon the sands of inexperience. Men with a broad surgical training first made this field possible as a surgical speciality, but others have occupied the territory without this preliminary schooling, and finding it, as they think, a very small field, branch out, spread themselves thin, and ceasing to contribute to its productiveness as a special field, become general surgeons of less than the average reliability. This is the top-heaviness to be avoided in specialization.

Gynecology, of course, as a special field of work has hardly been brushed, as doubtless will be evident some decades hence when the re-entry of new individuals on the old soil, with new methods, new machinery and a new spirit of investigation, will point a moral to our earlier selves. There has never been a day in surgery without those who have held that the highest attainment of the art has been reached, not only in general, but also in their particular fields.

This is the beginning of the end, I think, of all operative specialties. The specialty is the measure of the man. So long as there are individuals capable, after a general training, of working along novel lines and with the imagination for research which leads to contributions, so long will the field of their endeavors justify its being regarded as "special"; and it is almost impossible to make definite advances in one direction without permitting other work to go by the board. But so soon as progress lags and by the time others with no broad conceptions have crowded in, what was once specialization becomes properly absorbed again in general surgery, until perchance other pathfinders crop up whose work brings on a new cycle.*

In no department of Medicine to-day is there greater promise of immediate reward or greater need of intensive surgical cultivation than exists in neurology, which so far as the possibilities of operative therapy are concerned is about in the position occupied by gynecology twenty-five years ago—the days of tincture of iodine and the glycerine pack. There is urgent need and wide opportunity for a group of men rigorously trained in general surgery, in the neurological clinic and experimental laboratory, who can serve as pathfinders in the surgery of the central nervous system—men who are not merely capable of exposing the brain and spinal cord with full respect for the dire consequences of rough methods, but who stand abreast with the growing knowledge of the maladies to which these structures are heir. It must be obvious to all who peruse our numerous surgical text-books or converse on the subject with general surgeons, that the surgery of the brain and spinal cord means largely the surgery of their enveloping structures; and the methods of exposure—the getting in through the bony envelopes, by motors, burrs and what not, by the speediest osteoplastic methods and so on—is evidently the matter of paramount interest.

It is often appalling to find what disrespect is paid to the enclosed structures themselves as a consequence of this attitude. At a recent meeting, at which the subject of epilepsy was being discussed, a surgeon read a paper reporting twenty-five cases of epilepsy, with an astonishing percentage of "cures," and it came up in the course of the discussion that his method of treatment was "to sweep the index finger about between brain and dura" to be sure that there were no adhesions, and, in case there were evidences of tension, to insert the selfsame instrument in various directions into the brain substance "to be sure there was no tumor." Yet none of the neurologists present expostulated or showed astonishment!

In a recent consultation over a case of fracture dislocation of the spine resulting in an apparently total transverse lesion, which had been immediately operated upon without a preliminary, thorough neurological study, the area of anæsthesia corresponded to a level about three segments higher than the seat of the bony lesion—a level which could not possibly have been exposed by the incision which had been made. This finding was very confusing until it was learned that the operator, who with perfect skill and excellent technique had performed the laminectomy, had inserted his finger, at the close of the operation, into the canal "to be sure that there were no spicules of bone pressing on the cord higher up."

Such an appalling lack of respect for the most important and delicate structures of the body is doubtless far from uncommon. Instances could readily be multiplied. But the disrespect is not entirely confined to the surgeon, for the neurologist himself, having little familiarity with the hazards of surgery, may be responsible for the institution of measures as dangerous as those which the surgeon may undertake through lack of neurological knowledge. The recent suggestion, as a treatment for tabes, of peeling the pia-arachnoid from the back of the cord, as though this structure were a banana, is a case in point; and the indiscriminate puncture of the brain advocated by certain German neurologists in the

*There are, to be sure, surgical specialties older than gynecology which have long existed, with none of these unsettling manifestations, though evidences of temporariness are by no means limited to the special gynecological field. Ophthalmology, obstetrics and orthopædics, for example, have remained stable. It is interesting that at Guy's Hospital there was no special department until 1824, a century after its foundation, when an ophthalmic clinic was created. An obstetric department followed in 1842, and one for laryngology and for orthopædics in 1885 and 1907 respectively. But no longer, as in the past, can the chair in any one of these clinics be held by the general practicing surgeon, for it has recently been decided that specialists alone are entitled to conduct the clinics for diseases of the ear, throat, genito-urinary organs and orthopædics, on the grounds that special training and skill are necessary. On such a basis special contributions toward the advancement of knowledge may be expected.

hope of finding a cyst or abscess, or of removing a small fragment from which a tumor diagnosis can be made, is a measure to be put in the same category, by no means excusable merely on the ground that the nature of the malady justifies blind and dangerous measures. "The condition cannot be made much worse, therefore operate," is a surgical dogma that should be squelched with its perpetrator. It is a sadly common excuse for much meddlesome and misdirected surgery.

Let us come, after this long preamble, to our special subject of neurological surgery, some aspects of which I have chosen for particular comment.

THE BRAIN AND ITS ENVELOPES.

Tumors.—At the time of my former paper the reaction from the discouraging views of Agnew and Bergmann had begun to set in, largely as the result of rumors of Sir Victor Horsley's brilliant undertakings in a large series of cases,[7] and of scattered records of occasional successful operations at other hands. Most neurologists, however, retain far from optimistic views. Nor can we wonder, when we consider the fact that Allen Starr, who with persistent courage has probably had more tumor operations done for him than any other, has recently reported what he regards as his first "cure" of a case of brain tumor—meaning not only the removal of the growth, but a complete restoration to the normal with disappearance of the signs, general and local, which made the diagnosis possible.[8]

Five years ago tumor cases were few and far between in the Johns Hopkins clinic, and though at that time there had been no successful extirpations, we had begun to feel somewhat encouraged regarding the beneficial effects of purposeful decompressive measures. A paper written on this subject[9] was quickly followed by the citation at other hands of numerous past cases in which trepanation had served to lessen preësixting symptoms: the principle, in other words, was an old one. That relief of pressure in many instances had unexpectedly followed unsuccessful explorations for tumors had long been a matter of general knowledge, and Horsley, Weir and other forerunners in the work had been led to propose simple trepanation as an intentional palliative measure; but I am unaware that any author had previously suggested a purposeful decompression irrespective of possible tumor removal, and the utilization not only of a "silent" area, but also of overlying muscle to prevent too great protrusion of the herniating brain, or had ever emphasized the importance of decompressing at a distance from the growth as a preliminary measure should the brain prove to be under great tension.

However this may be, the decompression idea caught hold, and the frequent examples that have come under our observation of misdirected surgery, which results in making the patient worse, seem to have been born of an apparent misunderstanding of its most essential principles. Within the past few months we have seen two tragic examples of such errors. The patients, who had removable tumors in the left hemisphere, had been subjected to an exploration over the left central and precentral regions, with removal of bone and opening of the dura—a so-called decompression. In both cases the pressure symptoms had been largely relieved by the resultant hernia, but a complete motor aphasia and contralateral hemiplegia was the consequence in each case of the misdirected measure, leaving the patients in a most sorry plight.[10] Particularly when localizing symptoms suggest the presence of a growth in an important field of this kind, the greatest possible precaution must be taken to insure a sufficient reduction of pressure before opening the dura over the tense brain in the immediate locality of the lesion. This may necessitate two or three preliminary measures, as illustrated by the following recent case of suspected left prefrontal tumor:

A large bone-flap, so placed as to lay bare the anterior half of the left hemisphere, disclosed a dura so tight that it seemed inadvisable to lessen the tension by a lumbar puncture. Consequently a subtemporal decompression on this same side was combined[11] with the exploration, and the bone-flap was replaced after the dura had been opened merely over the silent temporal lobe. Though considerable improvement followed this palliative measure sufficient tension persisted to make a direct exploration hazardous; hence after a period of five days a right subtemporal decompression by the usual external intermuscular method was performed. Practically all the pressure symptoms subsided as a result of the bilateral subtemporal openings, and on the tenth day after the first exploration the bone-flap was again reflected, the dura was widely opened with only a slight degree of protrusion and a prefrontal tumor was disclosed and removed. This procedure was followed not only by abeyance of all pressure symptoms, but also by a rapid clearing up of the disorientation and intellectual disturbances which characterize lesions in this neighborhood.

A first-stage attempt to investigate the brain in this case would probably not only have resulted in failure to expose the growth, but doubtless would have led to symptoms comparable to those in the two cases cited. Thus in dealing with a tumor associated with extreme degrees of tension,[12] or with

[7] It is unfortunate that there is no published record of the ultimate results of his operations.

[8] Tumors of the acoustic nerve, their symptoms and surgical treatment. Am. J. M. Sc., April, 1910, CXXXIX, 551.

[9] The establishment of cerebral hernia as a decompressive measure for inaccessible brain tumors. Surg., Gynec. and Obst., 1905, I, 257.

[10] In one of the cases the tumor which actually proved to be largely post-Rolandic was removed, but the damage to the precentral cortex from the long-standing herniation was permanent.

[11] A method of combining exploration and decompression for cerebral tumors which prove to be inoperable. Tr. Am. Surg. Ass., 1909.

[12] It must be appreciated, too, that tension is always accentuated by a badly taken or poorly adminstered anæsthetic, and a second stage may be necessary owing to this factor alone. Expert anæsthesia, as cannot be too often emphasized, is a *sine qua non* in these procedures. Ether, too, possibly with a preliminary scopalamine or morphia and atropine injection remains the anæsthetic of choice, for reasons not apparent five years ago. In view of the inevitable hepatic necroses which follow chloriformization and the increased tendency to bleeding on its second administration, should one be necessary, the arguments in favor of anæsthesia by this drug in cranial operations have been greatly weakened.

a large and vascular growth, two, three or more stages may be essential to safety, however satisfactory it might be for all concerned if the lesion could be removed at the first sitting. It is needless to say that essential to the ultimate success of a performance necessitating the reopening of a large osteoplastic wound is the absolutely reactionless healing which alone is assured by a tedious, painstaking and accurate closure with early removal of the external approximating sutures.

We have had at this writing about 180 patients suffering from brain tumor, the larger number of them having been admitted during the past two years—namely sixty-four from October, 1908, to October, 1909, and nearly an equal number from October, 1909, to date. Some 250 operations [13] have been performed on these patients, including such preliminary measures as a subtemporal decompression for the relief of headache and preservation of vision before localization was possible.

Blind patients fortunately are brought to us less often than was the case a few years ago, and it would be interesting to compare the figures of the first fifty admissions in this respect with those of the last fifty. I should judge that they would be less than half as frequent in the latter.[14] Allowing a patient to become blind from the pressure of a tumor which does not directly implicate the optic paths is comparable to procrastination in appendicular disease until the onset of general peritonitis. The more or less satisfactory settling of the choked disc question has been in large measure responsible for this forward step, and ophthalmologists are now awake to the incipient grades of this lesion which previously were overlooked or, regarded as an "optic neuritis," were considered as something unrelated to pressure. Familiarity with the ophthalmoscope is an essential to this work and, thanks to the electric attachment, the old difficulties encountered in its acquirement have fortunately been greatly lessened.

For two or three years Dr. Bordley and I made repeated observations (daily in many cases) on the eye-grounds of the patients who were beginning to come to us in some number, and the conditions before and after decompression, not only in the tumor cases, but in other states of increased intracranial tension, soon convinced us of the essentially mechanical nature of the neuroretinal stasis and œdema. Similar studies have led Saenger, Hippel, Horsley, Paton, de Schweinitz, Schieck and others to similar conclusions.[15] An early grade of choked disc long remained the most delicate test which we possessed for the recognition of a tumor, and it was the custom to await its onset, for few ventured, five years ago, to make a diagnosis of tumor in the absence of headache and vomiting combined with choked disc.

In the course of our affiliated work routine perimetric observations were made of all suspected tumor cases before and after operation, and we found to our surprise that with great regularity a characteristic alteration occurs in the boundary relations of the color fields. This shows itself as an interlacing or actual inversion of the outlines of the color fields and seems to affect blue more than the other colors—a condition long regarded as typifying hysteria. The interlacing disappears promptly, as a rule, when sufficient relief from pressure has been brought about by surgical means; and what is of greater importance than all else, the condition is often demonstrable before there is any recognizable ophthalmoscopic alteration appreciable in the retina.

Six of our patients in the past year, in the total absence of a choked disc, have been subjected to operation largely on this basis; and some of our most satisfactory extirpations have been in this group. One patient had shown this change in the fields for over a year before we could bring ourselves to believe that he was carrying a tumor, for he had never had a headache, never any dizziness or gastric upset. Mild Jacksonian attacks starting in his left foot constituted the only symptom, and yet a benign tumor—an endothelioma weighing 200 grams—was found and removed, with complete recovery. This is the largest tumor in the series that was successfully removed: two larger ones, weighing 400 and 420 grams respectively, occurred in children who had long been thought to be hydrocephalic.

In only two out of about one hundred cases examined has all tendency to color inversion been totally absent. These were both cases of supposed cerebral arteriosclerosis with aphasia and focal epilepsy originating in the facial musculature. There were no pressure symptoms whatsoever in either case, but in each an exploration disclosed a small glioma in the lower precentral area. It is to be hoped, in spite of such exceptions, that the sign may nevertheless prove of value, for anything which will enable us to make an earlier diagnosis will be of untold benefit to these unfortunates.

Brain tumors are surprisingly frequent, and the diverse maladies for which the patients in our series had been treated for years, since many of these growths are slowly progressing affairs, would be a most distressing commentary on our diagnostic guesswork—the diagnoses, or shall we say guesses, ranging all the way from gastric headaches and eye-strain, arteriosclerosis, hysteria, neurasthenia and what not, to dementia, hydrocephalus and toxic amblyopia. Most common

[13] In these figures the first, second or third stage of a single procedure is not counted as a separate operation.

[14] I may, however, be too optimistic. At the present writing three patients from distant points have been admitted as follows: (1) A young man with a definitely localizable and approachable lesion had been subjected, until totally blind, to a rigorous antiluetic treatment for two years. (A temporal lobe cyst was found: he has recovered, though permanently blind.) (2) A respectable woman, needing decompression for an unlocalizable tumor and whose relatives had indignantly submitted for a year to an antisyphilitic regime, has become completely blind in the process. (3) A child of five years, having had mercurial inunctions for nine months, was brought, blind, hemiplegic and unconscious. (A large subcortical cyst—degenerated glioma?—was disclosed at a second-stage operation: the child has recovered, blind and hemiplegic.) The Wassermann reaction was negative in all of these patients: in none of them was syphilis remotely probable.

[15] Horsley's valuable paper ("Optic Neuritis," "Choked Disc" or "Papillœdema." British Med. Jour., March 5, 1910) should be consulted.

have been the diagnoses of functional disturbances insisted upon by the attendant until the pressure symptoms became full-blown, and then always the possiblity of syphilis had been considered, with an antiluetic regime, which either had added to the gastric distress and loss of weight, or, what was as bad, seemed to relieve symptoms for a time, leading to an erroneous diagnosis while the vision continued to fail. Fortunately the Wassermann or Noguchi reactions to-day make this diagnostic test by drugs no longer a matter which deserves discussion.[16]

They are ticklish performances, these operations for tumor, and demand not only a rigorous regard for detail, such as the patient's position on the table and the choice of the anæsthetic, coupled with the highest skill in its administration, but also a thorough knowledge of the diverse tricks of controlling hæmorrhage from scalp, meninges and brain, with a full understanding at the same time of the cerebrospinal fluid circulation under states of tension; for this latter is really one of the keynotes of success in these difficult problems, and upon the management of the fluid hinges not only most of the pressure phenomena which the disease elicits, but also the possibility of lowering tension during the operation in such way as to allow of dislocation and wide subdural exploration. The operation, in the hands of the inexperienced, must usually end with the first protrusion of the naked brain through an open dura, and when abandoned in this way, paralyses, a separated wound, an infected fungus, meningitis and death are, alas, too common. And it must be appreciated too that the management of the cerebrospinal fluid under these circumstances does not simply consist in its withdrawal by a lumbar puncture, for one of the most frequent causes of prompt fatality in patients suffering with tumor pressure is the wedged foraminal hernia which follows this ill-advised measure.

Our results, I am glad to say, are steadily improving with each block of cases, due doubtless to earlier diagnoses—for we now see proportionately fewer patients in the desperate terminal states of pressure—as well as to technical improvement in the various procedures, for barring such clean-cut lesions as those, for example, which constitute the group of lateral recess tumors, no two patients present exactly similar problems. In our last one hundred cases, over a period of eighteen months, there were eight operative fatalities in the first fifty and only three in the second fifty; there were only ten extirpations or six cyst evacuations with practical cures in the first fifty, and there have been twenty in the last fifty. In the entire one hundred, therefore, there have been thirty apparent (to all intents and purposes) cures, thirteen operative deaths and sixty-seven measures which have been definitely palliative. There has been a complete absence of the old-time post-operative complications. A meningitis or fungus cerebri is almost inexcusable to-day.[17] Some of the patients subjected merely to palliative measures have since died, some have been subsequently operated upon for tumor removal; but the majority continue well, many of them earning their livelihood. Brain tumors, be it known, are almost always slow-growing affairs, the more serious kind too—the gliomas—growths which tend to undergo degenerative processes, so that if not only room is made for them but time is also allowed they can be long carried without further symptoms provided they occupy silent areas; and this is the group of cases for which palliative measures are particularly indicated. It sounds like an Irishism to say that no tumor is so favorable for operation as one which cannot be localized, and yet it conveys much of truth.

Contrast these figures with the gloomy statistics built upon post mortem examinations, with only four per cent of tumor cases suitable for operation! It can be seen that there is enough surgical work among patients suffering from brain tumor alone for concentration—specialization within the field of neurological surgery. Without this specialization the work cannot be done well, for it is hardly a physical possibility to carry to a safe termination more than one of these arduous operations in a day, nor is it fair to the patient or to the subject we are discussing to undertake such work when fatigued or to crowd such operations into the midst of a busy day of general operative surgery. Then, too, hours of preliminary and of subsequent study are demanded by these conditions, as the neurologist well knows; and the neurological surgeon must look at his subject from the neurologist's standpoint and must make his own diagnoses, just as do the better men among those who are contributing to the surgical therapy of the diseases of the alimentary canal or genito-urinary tract or pelvic organs or ductless glands, as the case may be.

Headaches.—One by-product of the decompression idea which has aroused our interest has grown out of the striking relief from the intracranial discomforts experienced by patients with tumor, through the establishment of a subtemporal defect in bone and dura. This matter concerns those unfortunates who are constant sufferers from intractable migraine. There are many types, of course, of hemicrania and many causes for it, but in one familiar group there occurs during the attack a marked arterial dilatation of the temporal vessels accompanied by a venous congestion which is seen best in the external branches of the ophthalmic vein, but which is observable, too, by the ophthalmoscope in the eye-grounds. Ptosis, pupillary inequality, vomiting, slow pulse and other familiar symptoms, associated at times with a low grade of

[16] Confusion is often rendered worse confounded by the fact (1) that the pressure symptoms of a glioma may temporarily subside under mercury and iodide, and (2) that the fibrous gumma is notoriously resistant to these same measures. It is to be hoped that Ehrlich's new arsenical preparation will be as effective in the absorption of this form of syphiloma as it promises to be in the earlier lesions of the disease; thus obviating on the one hand the necessity of considering these cases as surgical and on the other of the protracted mercurial treatment of the present and past.

[17] Though it is our invariable rule to shave and cleanse the scalp on the operating table before anæsthesia, with no preliminary ward preparation, there has never been a wound infection, meningitis, or, even with the tense hernia which may form, a broken wound leading to a fungus cerebri.

choked disc, accompany the attacks, and a number of these individuals have submitted with eager willingness to the experiment of a subtemporal decompression, which has resulted in a considerable measure of relief in most of them. What encourages us to believe that the step is in the right direction is the fact that when subsequent headaches occur there is evidence of increased tension shown by a tendency to protrusion at the seat of the defect, which becomes flat again, or even recedes, with the free interval. The seizure would seem to be brought about by some local nerve discharge acting on the blood vessels and causing pressure from a circumscribed œdema, possibly of the nature of an angio-neurotic œdema. Nevertheless it must be admitted that the matter demands much longer study before it can be advocated on a sound basis of therapy.

Intracranial Hæmorrhages.—Possibly no one of the recent contributions to the surgery of the head has proved so simple or has been so satisfactory as the decompressive measure, whether unilateral or bilateral, as the case demands, for basal fractures. This procedure has become more or less routine in our clinic, and has been put upon such a basis that it may safely be regarded as a task for the general surgeon. The same, unfortunately, cannot be said as yet of the traumatic intracranial hæmorrhages of the newborn nor for the hæmorrhages consequent upon vascular disease in the adult.

Since my first paper suggesting intervention for birth hemorrhages,[18] in which four cases were reported, the opportunity has arisen to make similar attempts on twelve other infants, several of whom were in a desperate condition, extensive contusion of the brain being associated with lacerations of its enclosing structures. About half of these patients succumbed during or soon after the operation, but some made excellent recoveries without the dreaded spastic paraplegias which Little was the first to ascribe to these accidents of birth. The second of the cases described in my original report is now a healthy and normal child of five years of age. Unfortunately I have lost track of the third child, which also made an immediate surgical recovery. Several of the later patients have also done remarkably well, though in one or two of them, doubtless due to complicating extravasations in the basal ganglia, athetoid states have supervened. The surgical procedure is usually well borne, which is not suprising when we consider the inevitable trauma which nature has fitted the child's head to endure successfully even at a normal birth. But the procedure is a delicate and difficult one, and until much more can be learned regarding the late results and the best methods of procedure I do not feel that it can be widely advocated for general use.

The same applies also to the question of apoplexy. I feel that much of the damage which occurs in these conditions is due to compression from the extravasation and to secondary œdema rather than to actual destruction of important nerve-paths—an explanation which also applies to the paralytic symptoms of tumor cases—and it would seem rational, if we are to regard patients with cerebral vascular disease as deserving of such radical measures for their relief, to attempt the removal of the clot, even though it be intracerebral, just as we would were we dealing with an extracerebral extravasation. A note was made some seven years ago[19] in a Mütter lecture of our first attempts in this direction, and since then there have been possibly a dozen cases operated upon, most of them in the terminal stages of compression. There have been one or two excellent recoveries, but whether they would have been equally satisfactory without the operation must remain a matter of some uncertainty until a much larger group of cases has been studied and a much longer interval has elapsed. Our attention has been drawn into other fields, but I feel that any one who would devote himself to this particular subject might hope for valuable results.

Hydrocephalus.—Possibly no condition is looked upon with a more general feeling of helplessness than infantile hydrocephalus, with or without the frequently combined spinal defect. That we shall some day find a rational method of surgical treatment for these cases I have not the least doubt, but it is very unlikely that it will come from indiscriminate attempts at drainage, for which some thirty different methods have already been advocated. The underlying factor of cerebrospinal fluid circulation must first be worked out, for it is this which is at fault; and whether there is an excessive activity on the part of the choroid plexuses or whether there occurs an obstruction at some stage between the plexus and the points of exit of the fluid from the cranial chamber, is not entirely clear.

Though we are learning much in regard to the acquired forms of hydrocephalus due to obvious obstructions, the "essential" or "idiopathic" hydrocephalus—so-called because we have never thus far been able to solve its mysteries—is still most baffling. Its elucidation will only come, I am sure, to the one who clears up the development of the ependymal and meningeal spaces and who can show us the normal outlets of escape from the arachnoid. That the fluid is constantly being formed, that its main normal escape is from the subarachnoid space into the dural veins and sinuses, that it has a close association with the venous rather than with the lymphatic system, that it is a carrier of secretion elaborated by the posterior lobe of the hypophysis, that in most of these cases of "essential" hydrocephalus the fluid actually finds its way from the ventricles into the subarachnoid spaces, so that the former can be emptied by a lumbar puncture, making absurd most of the advocated methods of drainage—all this and more has been learned. Moreover, it is a well-recognized fact that hydrocephalus—since it is only a symptom of disease and not a disease in itself—is found in a great variety of pathological conditions, each of which will demand its particular form of readjustment to assure the proper fluid drainage. I hesitate to say how many harrowed parents apply for surgical relief for hydrocephalic offspring,

[18] Concerning surgical intervention for the intracranial hæmorrhage of the newborn. Am. J. M. Sc., October, 1905.

[19] The blood-pressure reaction of acute cerebral compression, illustrated by cases of intracranial hæmorrhage. Am. J. M. Sc., June, 1903.

or how many of the cases have been operated upon, or how discouraging have been most of the results. Of one thing I am convinced, that we are only at the threshold of this subject and that it is large enough to need its own specialization.

Epilepsy.—Here, again, we are dealing with a symptom of disease, for the use of the term "idiopathic" or "essential" is again an acknowledgment of our ignorance of the etiology. Hence in speaking of the surgical treatment of epilepsy we must not overlook the fact that in an ever-growing number of cases we are dealing with convulsions of recognizable organic origin, be the cortical irritant a tumor or a cyst, local vascular disease, the relic of an old inflammatory process, or a gliosis set up at the seat of an old traumatic extravasation however minute.

With Dr. Heuer, I have gone through our voluminous tumor histories with the object of determining the number of patients in this particular group who have suffered from seizures of an epileptiform character. In 130 consecutive cases, convulsions were recorded in 53 (40.7 per cent), and of these patients, 27 had typical motor Jacksonian attacks—practically the only symptom of tumor in a certain number of them, so that, as Allen Starr emphasized many years ago, these cases should always be explored on the suspicion that a cortical new growth in a removable stage may be responsible for the symptom. This in the past has applied only to paracentral lesions with motor fits; but now it is possible, thanks again to Hughlings Jackson, to recognize some forms of seizure which have originated from cortical lesions elsewhere—the uncinate gyrus group of fits, for example, of which nine instances have occurred in our series. It must be realized that a lesion identical with that which evokes a characteristic Jacksonian attack when in proximity to the motor cortex, may, when situated elsewhere, elicit what appears to be a general convulsion without warning.

A lesson is to be drawn from the experience with these tumor epilepsies; namely, that the attacks, if they have been of long standing, may continue even though the growth, obviously their original cause, has been cleanly and totally removed. There is a certain basis, therefore, for the common idea of the "establishment of an epileptic habit," which means nothing more than that certain fixed alterations occur in the cortical cells which make them more liable than formerly to discharge under a certain stimulus—whether chemical through autointoxication, or mechanical from varying degrees of intracranial tension, or vascular through blood-pressure changes. This point furnishes one further inducement to precocious explorations in incipient epilepsy whenever there exists an element of suspicion that a focal lesion due to an original trauma or infection is present.

In Keen's system of surgery two years ago I summarized the fifty-nine cases of general epilepsy which I had operated upon up to that time, and stated that 50 per cent of the patients had been so far benefited, temporarily or permanently, as to make the operation seem worth while. We have had almost as many more cases during the past two years showing proportionately about the same degree of benefit. Just why these patients should have such a marked subjective sense of relief and so frequently a complete cessation of seizures for a time, I can offer no satisfactory explanation. In a small number of cases the operation has apparently resulted in a cure with complete abeyance of the attacks for a number of years, and this too not infrequently in cases which appeared to offer the most unpromising surgical risks: whereas on the other hand, many of those which, surgically speaking, were most promising have relapsed again practically into their former state.

There are many factors to be considered in an analysis of these cases, such as the preëxisting duration of the malady, the number, severity and character of the attacks, the after-treatment and environment, the lesion found at the operation and the procedure employed—extirpation, arachnoid drainage, ventricular puncture, decompression or what not—too many factors, indeed, to justify an analysis in a general address.

Dyspituitarism.—Hidden in a foot-note in the paper of five years ago I find this statement, "It is not impossible that a diseased pituitary body may some day be successfully attacked"—probably, I meant, in the next generation. To Kipling's story of the "Night Mail" there are appended fictitious advertisements of flying machines and their accessories culled from presumptive newspapers of the year 2000. An energetic house in England in advertising their present sale of such articles has called attention to the fact that according to Mr. Kipling they are ninety years ahead of time. It would require the imagination of a medical Victor Hugo to forecast what the surgical activities even of the immediate future may be.[20]

But much more important than the mere happening of certain successful operations for the treatment of lesions in the infundibular region which have implicated the pituitary body, is the greater fact that through these efforts and the associated experimental work, diseases hitherto mysterious are beginning to be understood. Surgery here can occupy the same rôle that it played in the diseases of the thyroid gland. But surgeons should eagerly acknowledge their debt to a neurologist—Marie—who was the first to point out the association of a pituitary body lesion with a definite clinical syndrome, and to other neurologists who have led the way in throwing further light—so far as light can be thrown by clinical investigation alone—on other and correlated maladies of hypophyseal origin. Furthermore, from an anatomical point of view the hypophysis is an intracranial structure—the "brain gland" of our forebears—and doubtless its normal secretory relationship to the cerebrospinal fluid makes the gland in a way as important to neurology as its membership in the family of ductless glands renders it of importance to general medicine.

[20] The suggestive papers of Marburg and of Pappenheim (Virchow's Archiv, 1910) indicate that the pineal gland is deserving of special experimental investigation and may prove to have an importance to the economy other than as a vestigial seat of the soul.

Our brethren, the rhinologists, I am told, wish to take this structure unto themselves as a partial denizen of the nose, and doubtless they can find their operative way to it as readily as can any others. But no matter who takes the lead and by further investigation advances our knowledge of this fascinating structure, let the clinical applications come primarily and exclusively as the result of serious experimental research, not as the chance experience of an isolated case or two of hypophyseal cyst or tumor operated upon by a single individual. Such sparring for a small prize temporarily blackens the eye of surgery, for, though he may not know it, conservative surgery is the natural opponent of the casual operator. Such was the story of brain tumors in the eighties. The men who are making aerial flight a thing of the near future are not the "spellbinders," thrilling as their individual flights may be, but the men who, like Langley and the Wrights, are working at principles.

The hypophysis and the ductless glands in general so influence the function of every organic process that they overlap into every individual specialty, and it is a free-for-all race, but one beset with so many obstacles that progress toward the goal will be slow. Newton once likened the sons of men to children, who on the beach of knowledge pick up a pebble here and there, while the wide ocean of the unknown lies stretched before them. We shall doubtless have to drain it to its dregs before all the pebbles relating to any single subject will be disclosed.

It has been learned that the anterior lobe of the gland is essential to life, and that it bears a close relation to such disturbances of growth as are displayed in gigantism, acromegaly and certain forms of infantilism. The infundibular lobe, on the other hand, is closely bound up with metabolic processes, and in view of the discovery that its secretory products are present in the cerebrospinal fluid this pars posterior must take on a new importance in many morbid states closely related to the nervous system.[21]

Surgically speaking, despite the demonstration that the sella turcica is accessible, we are still working in a dim light, and the proven importance to life of the glandular structure which rides in the saddle must breed hesitation in the minds of those who would dislodge it offhand. As yet the surgical problems should properly be restricted to the relief of neighborhood symptoms brought about by new growths which have either originated in the gland itself or have arisen from adjoining structures. No one as yet would venture to assert that a tumor in the infundibular region can be totally removed, and inasmuch as pituitary headaches and pressure against the chiasm may be relieved by a local decompression or by the chance evacuation of a cyst, it would seem wise, for the present at least, in view of the importance of the gland, to confine operative measures in most cases to the mere removal of the sellar base with incision of the glandular capsule —a local decompression. Hypophyseal tumors which have extended from the infundibular region into the cranial chamber proper must be treated by the same rules of cerebral decompression as would be applied to any equally inaccessible lesion elsewhere.

An attempt will soon be made to correlate the clinical studies of our 20 cases of hypophyseal disease in man, with the experimental observations conducted in the Hunterian laboratory by Reford, Crowe, Homans, Goetsch, Dandy and Jacobson. Symptoms due to a primary or neighborhood disease are often more or less obvious, but those due to a secondary implication of the glandular activity from a lesion elsewhere are a far more common sequence of intracranial maladies than is generally supposed.[22]

The Spinal Cord.

Meningitis.—Far less that is new has been added during these five years to our manipulative therapy of lesions of the cord than of those of the brain. The temptation is to dwell on Flexner's remarkable achievements rather than on matters surgical, for his past work has resulted in the prevention of many of the surgical complications formerly a consequence of meningitis and his present investigations on poliomyelitis when carried to the end may have an even more striking tendency in this same direction. There are some sequels of cerebrospinal fever, however, which present surgical problems during the course of serum treatment or even when recovery has been brought about by its use.

It has been pointed out that all of the fatal cases die with, if not in consequence of, an obstructive hydrocephalus,[23] so that intraventricular as well as the usual lumbar subarachnoid introduction of serum may be indicated. Indeed, in one of our cases, when organisms were no longer demonstrable in the spinal fluid, they were present in abundance in the distended cerebral ventricles. It is possible, therefore, that drainage of the ventricles (temporarily to the outer world, or permanently to the subdural space by the ingenious callosal puncture method, introduced by von Bramann[24]) may be therapeutically applicable to this frequent complication. Then there are certain late disturbances which may supervene after apparent recovery—epilepsy, for example, and spinal paraplegia, both presenting problems for operative treatment.

[21] Concerning the Secretion of the Infundibular Lobe of the Pituitary Body and its Presence in the Cerebrospinal Fluid. Am. Journ. of Physiol., November, 1910.

[22] A note of caution in regard to the therapeutic use of hypophyseal extracts may not be untimely—particularly as their employment is being recommended for certain surgical states. Operators grasp eagerly for any blood-pressure raising substance which can be employed in shock, as was disastrously the case with adrenalin. Pituitary body extracts which are "on the market" advertise to the unsuspecting that they occasion a more marked and more enduring rise in arterial pressure than adrenalin. Unfortunately the gland appears to contain two substances, one of which produces as marked a depressor as the other does a pressor response, and until they can be separated, therapeutic administration in cases of low blood pressure might prove most dangerous.

[23] Obstructive hydrocephalus following cerebrospinal meningitis. J. Exper. M., 1908, X, p. 548.

[24] Bewerthung des Balkenstichs in der Hirnchirurgie. Arch. f. klin. Chir., 1909, XC, Nr. 3.

Some of our best results in epilepsy have been obtained in this group of cases, and a number of patients in whom a progressing spinal paraplegia had developed, have been much benefited by a laminectomy. In some of the patients who suffered with severe pain the posterior roots have been divided, and in all of them the chronic adhesive arachnoiditis, often with so-called serous cysts, has lent itself to surgical betterment. Into this same category fall the cases which have been given the sonorous name of "arachnitis adhesiva spinalis circumscripta." Oppenheim, Krause and Horsley, among others, have called particular attention to these encysted accumulations of fluid in the arachnoidal spaces which may cause pressure disturbances akin to those associated with a new growth; and doubtless all who have performed many laminectomies for a presumed tumor syndrome have had the good fortune to encounter this condition, which lends itself favorably to operative treatment.

The acute tuberculous and pyogenic infections still waver on the borderline of surgery. It is remarkable that a tuberculous meningitis, regarded as inevitably fatal, should show so little for itself after death, for one must often scrutinize the meninges for the presence of tubercles even though the bacilli have been demonstrable in the cerebrospinal fluid during life. On the assumption that a supervening serous meningitis has been responsible for these fatalties we have drained the mid-subarachnoid cistern through a median occipito-spinal opening—an operation easily performed—with obvious temporary improvement, which, however, merely served to postpone the seemingly inevitable outcome. It is possible that a callosal perforation may here again be applicable, for a hydrops ventriculorum tends to form in these cases just as it does in the course of the meningococcus infections.

Much better results have been obtained from permanent drainage in the cases of serous (non-tuberculous) meningitis and in those of pyogenic origin. A number of patients suffering from an established general streptococcal or pneumococcal infection have recovered after the establishment of free drainage coupled with the administration of urotropin. One could wish that Crowe's discovery,[2] that this drug quickly finds its way into the cerebrospinal fluid, might be applied to cerebrospinal fever as an adjunct to the serum treatment. There is no doubt, however, that its chief value will be as a prophylactic measure in conditions such as otitis media or sinusitis or basal fractures in which meningeal infections are threatened. On this basis it might well deserve a vigorous trial during the only too brief prodromal stage of acute poliomyelitis, or be used as a general prophylactic in localities where the disease is epidemic, as quinine is employed in malarial districts.

Tumor.—We have had a number of cases of spinal tumor, and possibly there is no performance in surgery more interesting and satisfactory than the diagnosis and localization, followed by the removal from the spinal canal of one of the benign meningeal endotheliomata. The subsequent relief from excessive pain and the resurrection from crippledom of one of these unfortunates are chief among the things which make for optimism in neurological surgery. It is astonishing how great a degree of recuperation exists in some of these flattened cords. In one of the cases in our series of six—a woman with total paraplegia of two years' standing—the cord was found thinned to a flat band of a few millimeters, and yet she has regained almost complete control of the extremities and walks freely without crutches.

The principle of decompression, furthermore, is often as applicable to the intramedullary tumors of the spinal cord as it is to the subcortical tumors of the brain. Among a number of cases of this sort the following may be cited as a notable instance of improvement after spinal decompression:

A young woman whose symptomatic history was confused by an early poliomyelitis followed by an extreme rotary curvature of the spine, began to lose control of her legs and visceral reflexes, until the lower body was almost totally paralyzed. There were no root pains, but she suffered from severe suboccipital headaches, and the diagnosis was obscure. A long S-shaped laminectomy disclosed a tense, pale cord which, filling the canal to the complete exclusion of fluid, bulged outward through the dural opening. A longitudinal incision in one of the posterior columns revealed a columnar glioma, a portion of which was removed for diagnosis, and the laminectomy was further enlarged upward until it included eight vertebræ before the upper limit of the extreme spinal distension seemed to be reached. There were almost immediate signs of returning function, motor and sensory, and she has so far recovered as to make us regret that the posterior column was not slit throughout the entire length of the exposed and tense cord. It is possible that such a neoplasm may degenerate, as in the case of some of the cerebral gliomata, into a cystic lesion of syringomyelic nature.

There is another form of palliation which may save from much suffering those unfortunates who have a malignant (metastatic) involvement of the cord which is beyond surgical attack—namely, the deliberate transection either of the entire cord or of the posterior columns alone, cephalad to the lesion. An immediate suprapubic drainage will suffice to keep these pitiable individuals clean, and they may be spared months of pain of such a nature and of such severity, under the usual circumstances, as to so far prohibit movements of the body that bed-sores develop even under the best of care.

Trauma.—In view of the recoverability of function in cords flattened by the pressure of tumors, one might argue in favor of equally satisfactory results in the case of traumatic injuries. This, alas, does not follow. On the one hand the slow compression effect leads to a physiological "block" to the transmission of impulses, which, however, is rarely if ever functionally total, the reflexes usually being retained while the paraplegia is of a spastic type in which spasmodic and uncontrollable movements occur. On the other hand there has been a laceration of the cord with an anatomical division of the conducting paths which makes a lesion beyond repair, and transection itself permanently abolishes the deep reflexes and gives a flaccid paraplegia.

I do not feel that on operative grounds I have anything to add to the subdivision of traumatic spinal injuries into three

[2] The excretion of hexamethylenamine in the cerebrospinal fluid. Johns Hopkins Hosp. Bull., 1909, XX, p. 102.

groups as made five years age—the hæmatomyelias, the total transections and the partial transections. The first—an easily recognizable condition—should not be operated upon, as it is in large measure a recoverable lesion, which cannot be bettered by surgery and may be made worse. The second, if it can be recognized without qualification, should not be meddled with, as the condition is hopeless beyond repair with or without surgical intervention. The third may and should be operated upon as soon as the diagnosis is made, provided the operator's experience is such as to insure no further damage to the cord in the effort to free it from pressure and relieve it from the effects of a progressive œdema.

It is possible that we cannot rely as definitely as Bastian would have had us believe, on the permanent as well as immediate abolition of the deep reflexes in cases of total transection, for there have been a number of cases recorded of total cross lesions (proven to be such post mortem) in the cervical region in which deep reflexes have returned; and I have seen two or three striking instances of similar restoration in cases which presented all the signs of totality immediately after the injury. One cannot, therefore, speak at all times with positiveness in regard to totality of transection, and final judgment on the individual problem must needs be influenced by associated circumstances. One can, however, do much for the cleanliness and comfort even of these desperate cases; and an early suprapubic cystostomy with the snug insertion of a tube through a small, widely stretched opening will usually avoid the renal infection which under repeated catheterization was formerly inevitable. Urethral drainage is far less effective. Fortunately these cripples rarely suffer physical discomfort and life may be tolerable and hopeful.

Something may be said as to operative methods in laminectomy, for an entry accompanied by rough manipulations is just as much to be condemned here as in operations on the brain. A temporary increase of preëxisting palsies is an evidence of operative traumatism, not to be excused on the basis of œdema or otherwise laid at nature's or the patient's door. The proposed osteoplastic operations are assuredly inadvisable, and I adhere strongly to the old total removal of spines and laminæ. The operation is actually a very bloodless one if the incision is absolutely median and the spines and laminæ are closely hugged and scraped of their periosteum. With this precaution new bony arches may almost totally reform, as we have had occasion to learn in a number of cases with secondary exposures, and the column seems to be weakened in no respect, even after an extensive removal. In one patient, during the course of three investigations for a presumed tumor, although all laminæ have been removed from the first thoracic to the second lumbar inclusive, his back is strong and no mechanical support is required.

Rather than saw through the laminæ or chip them off with gigantic forceps I prefer, after removing the spines, to enter the canal with a perforator and large burr, introduced successively at the amputated base of each spine. The lateral fragments of the laminæ can then be nibbled away with sharp-nosed rongeurs. This method of entry not only spares the operator's reflexes for the delicate work to follow, but avoids all jar to the cord. After the median extradural fat has been scraped from the dura this membrane should be incised on a director with such care as not to injure the subjacent arachnoid which bulges into the wound and through which, under normal circumstances, the contained structures can be beautifully seen as if magnified through a glass. If a looked-for tumor is not exposed a delicate filiform catheter may be readily passed upward between the dura and uninjured arachnoid as high as the foramen magnum, if there is no obstruction in the canal such as would be produced by a growth. The preservation of the arachnoid and its contained fluid is desirable as an immediate aid for these primary explorations, but not for the reason that evacuation of the fluid is dangerous. We at least have never seen any untoward symptoms result from its complete outflow so long as the patient's head is not elevated; and I am inclined to ascribe the oft-mentioned "spinal shock" to the loss of blood and trauma incidental to rough methods of entry rather than to escape of fluid. These spinal wounds of course should never be drained.[26]

The Peripheral Nerves.

The surgery of the peripheral nervous system, at least so far as the nerves in their extracranial and extraspinal course are concerned, has long been a field of "external surgery," and much of our knowledge of the effects of injury and recoverability after suture dates from the past century, which has also brought down to us the tradition of perverseness which makes nerves reunite when this is undesirable and prohibits functional union when it is longed for.

Harrison's remarkable studies which were in progress at the time of my earlier paper, have since added further knowledge to the question of possible peripheral auto-regeneration which was then exciting much discussion. By the further aid of experimental surgery on embryos he has succeeded in bringing the living fiber under direct observation[27] during its early formation. The nerve fiber develops primarily as an outflow of protoplasm from its central cell, the end of the fiber showing a filamentous structure possessing motile characteristics which draw out the protoplasmic thread into its permanent axonal form, no other cells taking part in the process. This amœboid property doubtless appertains to the regenerating central end of the divided adult fiber and is doubtless what leads to reunion of a severed nerve in the adult; the sheath of Schwann cells of the peripheral segment possibly playing some chemotactic rôle, as experiments have suggested, in attracting the axone toward its old path, but certainly taking no direct part in the reformation of a sep-

[26] An ingenious unilateral laminectomy has been introduced by Alfred S. Taylor, with which I have had no experience but which I should judge would leave too narrow a defect in the column for any manipulations within the canal other than the simple root divisions, for which purpose I understand the operation was devised.

[27] Observations on the living, developing nerve fiber. Anat. Record, 1907, VII, p. 116.

arate peripheral axonal segment. Harrison has also shown that in certain frog larvæ there may be such a thing as primary protoplasmic union of axis cylinders without degeneration. Studies such as these make far clearer our working conceptions of the processes of reunion of old or newly divided peripheral segments with their original, or, after grafting, with new central ends. The delicate amœboid end of the newly growing axone cannot well respond to the peripheral call when an abundance of scar tissue is interposed, particularly when the tendency to its formation is augmented by the presence of bulky silk sutures. Experimental studies, however, have not as yet shown why it is that sensory fibers show a much greater tendency to reunite than motor fibers. If the reverse were true, much of our peripheral nerve surgery would be rendered easier.

Important additions to our knowledge of the afferent system have come from the exhaustive clinical researches undertaken by Henry Head[28] and his co-workers, Rivers, Sherren and Thompson. A painstaking investigation of a long series of nerve injuries which culminated in the subjective studies of the anæsthetic skin-field produced by purposeful severance of the superficial ramus of the radial in Head's own arm, led these authors to subdivide the sensory mechanism into three systems, which convey impulses of (1) deep sensibility, (2) protopathic sensibility, and (3) epicritic sensibility. These studies have shed a new light on certain factors relating to sensory restoration which have long puzzled surgeons and which have either been explained on the basis of overlapping or at times entirely misinterpreted as an immediate return of function after suture. The "protopathic" system of Head regenerates with rapidity and completeness, even when the true cutaneous supply ("epicritic") remains cut off, and he regards it as one with the afferent fibers of the visceral sympathetic. This particular system is incapable of appreciating touch and slight degrees of warmth and cold; all stimuli are imperfectly localized, radiate widely and are often referred to distant parts as painful impressions. Their detailed and systematic investigations of about sixty cases of nerve injury have not only given us many important new facts, but have set a standard of thoroughness which can be attained by few others.[29]

Nerve Anastomosis.—Five years ago the first cases had just been recorded by Ballance, Faure and Kennedy, of what has since proven to be the most satisfactory application of the astonishing fact that controllable impulses from given centers may come to traverse a newly established pathway to a paralyzed group of muscles. No better chance for a clear-cut physiological test could have been given than the anastomosis of the peripheral segment of a paralyzed facial nerve with the central end of another motor nerve destined by nature to innervate an entirely distinct musculature. The spinal accessory had been used in the earlier operations, and in our series of fifteen subsequent cases this form of coupling has been adhered to.[30]

From what we now know of the processes of nerve reunion we are the better able to understand the more complete and more prompt restoration of an early graft, not only because of the atrophy of end-organs and muscle bundles, but because of the subsidence of the changes in the peripheral segment which presumably influence the downward projection of the new forming axis-cylinders. The most satisfactory functional results naturally follow an anastomosis made immediately after facial transection, such as may be intentionally performed in cases of troublesome motor spasm. In one of these cases,[31] observed with Dr. H. M. Thomas, restoration of function began within six months and the patient has regained almost complete *emotional* control—acknowledged to be a rare outcome under the best of circumstances.

In like fashion other palsies of important muscles-fields —trigeminal, laryngeal, vesical—lend themselves to nerve grafting with a prospect of improvement in direct relation to the promptness with which the measure is undertaken. Needless to say, the same thing has long been known to be true in the case of the mixed nerves of the extremities, though here another element, that of pain and sensitiveness, comes into play—an element which may stand in the way of the vigorous post-operative measures by electricity and massage necessary to keep the muscles from too great wasting during the long wait for functional restoration. These pains are associated with the return of function in the "protopathic" system of Head, and particularly in children the extremity in which these sensory changes—inevitable after severance of a mixed nerve—are going on, is so sensitive as to preclude massage and electricity.

But this is not the only obstacle to functional restoration by means of anastomoses in the muscle-group paralyses due to poliomyelitis. If, as we surmise, the well-recognized changes, which occur in the sheath of the peripheral segment, represent the chemotactic influences which allure the reforming axone to its old pathway and terminal, it can be readily understood why the outgrowing fibers do not distribute themselves indiscriminately among peripheral fibers, some of which have been long degenerated and some newly degenerated as the result of the anastomosis—why, in other words,

[28] The afferent system from a new aspect. Brain, 1905, Part CX, p. 1.

[29] Bardenheuer's studies of forty-three cases in his personal surgical experience should not be overlooked in a review of this subject. (Mittheilungen aus dem Gebiete der Nervenchirurgie, u. s. w. Deutsche Ztschr. f. Chir., 1908, XCVI, pp. 14-224.)

[30] Purely on the speculative basis that the cortical centers for the tongue were nearer the facial centers than were those for shoulder movements, and that associated movements might consequently be lessened, the hypoglosso-facial form of anastomosis was introduced as an alternative and seems to have been generally followed of late. Associated movements, however, are the same in both instances, and the thickness of speech in one case would appear to be more disturbing than the shoulder droop in the other. I have seen a considerable number of patients after hypoglosso-facial anastomosis, none of them with results comparable to those after accessorio-facial grafting.

[31] On the surgical treatment of facial paralysis. Tr. Am. Surg. Ass., 1907.

the new forming axones should discriminate in favor of the recently severed peripheral fibers which take them back to their original destination. It would presumably be necessary, in order to assure another distribution, to make the graft immediately after the onset of the original paralysis—obviously an absurdly impractical proposal.

We are still making a practice of anastomosing the ends of nerves severed in amputations, and certain unpublished experimental work lends support to the view that terminal neuromata are less likely to form under these circumstances, though, as before stated, this is trusting to the effect of negative polarity. The same measure has been applied to the nerve trunks whose terminals in old amputations have given rise to painful neuromata, with results which are in a measure promising.

Posterior Root Divisions.—Intracranial as well as intraspinal root division, chiefly for painful afflictions in circumscribed skin-fields, doubtless represents a crude method of dealing with these maladies and is justified only on the ground that less simple measures are as yet unavailing. However, even these radical procedures sometimes fail in inexplicable ways, as has been largely true of root divisions for post-zoster pains and for those associated with terminal neuromata. It is difficult to conceive of a central pain set up by a so-called ascending neuritis which will perpetuate discomforts referred to an area rendered permanently anæsthetic by root division. The procedure has been advocated as a form of relief for the gastric crises of tabes, and a few favorable reports of such operations have appeared. Our own restricted experience has not been brilliantly encouraging.

There is a present vogue for posterior root division as a palliative measure for the extreme spasticity of certain cerebral diplegias of the Little type, and though the valuable contributions of Förster and Gottstein and of Clark and Taylor in this direction are based on sound physiological principles[23] just how far we may hope to progress in this direction remains to be seen. "Preliminary reports," particularly in surgery, are too often bred of momentary enthusiasm, and any maladies which overlap, as do these, the boundaries of another specialty demand, for the end results, a long and patient wait with coöperative treatment.

The Facial Neuralgias.—In the trigeminal group of root divisions alone have the surgical results been eminently satisfactory—indeed, they are possibly the most satisfactory of all the major performances of neurological surgery. Unhappily the operation early acquired an unfortunate reputation which special work and perfected methods have not sufficed to entirely set aside; and most patients with major neuralgias present themselves with the full expectation of the loss of an eye, of an unsightly facial paralysis and of a probable recurrence of pain. Haphazard operating bred of inexperience is entirely responsible for this impression, and some of the most shocking examples of bad surgery filter through to the neurological specialist as the end results of former incomplete ganglion operations.

Fortunately, owing to the present widespread employment of the deep alcohol injections, largely due to Patrick's insistence on their effectiveness, much suffering has been spared and many needless and temporizing extracranial operations have been avoided. Neurologists in general would do well to make more use than they do of this form of minor surgery—a straw which shows the direction of the wind. However, in the true major neuralgias the injections soon lose their efficacy and further procrastination is unwise.

In consideration of the average age of the patients, their prolonged suffering, the protracted use of drugs and poor nutritional state, the mortality of the operation for trigeminal root avulsion is surprisingly low. We have had ninety consecutive cases without a fatality; the average hospital residence has been little more than two weeks; it is often impossible for the uninformed to subsequently tell, without sensory tests, upon which side the neurectomy has been performed; and in most instances the outcome is more of a rejuvenation than one sees after almost any other surgical measure. It remains, however—let this point be emphasized again—an operation not to be undertaken by the untrained surgeon. There are comparatively few operators who can resist the temptation to coquette occasionally with the more rare and more difficult operations. It is a failing common to the clan, and a vague feeling of satisfaction is experienced in placing them to one's supposed credit: but it is more often to one's discredit as time proves.

Straightforward and uncomplicated as the neurectomy may prove when done by an experienced team—for it is not an individual event—there are certain clinical facts in regard to these facial neuralgias which our comparatively long series of cases has brought to light. It has become clear that neuralgic pain referred to the trigeminal territory need not be conveyed by the fifth nerve, for in spite of a total and permanent post-operative anæsthesia of this sensory field, three of the patients in the series have had their pain absolutely unmodified by the neurectomy. They are all individuals whose extreme discomforts, referred primarily to the trigeminal area, have been of a continuous rather than a paroxysmal nature. All of them are patients for whom the operation was conducted with some therapeutic misgivings in view of the ineffective results of earlier peripheral injections and neurectomies. These were instances of obvious major neuralgia, rest assured, not cases which could be ascribed to any of the common lesions to which secondary nerve involvement may be ascribed.

[23] Charles Bell found that in the ass, after supramaxillary divisions of both trigemini, the upper lip was no longer elevated in feeding: he, consequently, thought that the nerves might be motor. Experiments in Exner's laboratory suggested that "paralysis" of the laryngeal muscles of the horse may follow section of the corresponding sensory nerve of the larynx. Finally, Sherrington has shown a most striking example as furnished by the ape, for after section of one of the afferent roots from the limb the grasp of the corresponding hand or foot is permanently lost, whereas if a single root is left there may be weakness, but total loss does not follow. In either case, however, the normal grasp may be elicited by stimulation of the appropriate area of the cerebral cortex.

There consequently are other possible sources of origin for the facial neuralgias of this type which we must carefully look for in the future—three sources in particular. Sluder's investigations have shown that an inflammatory involvement of Meckel's ganglion may occasion a more or less continuous and characteristic pain referred to the lower facial areas. Ramsay Hunt's clinical studies on auricular herpes have brought the sensory division of the facial nerve into prominence and have made it clear that geniculate neuralgias are a possible source of confusion; and such a report as Weisenburg has recently made of a case of supposed neuralgia quinti major which had been subjected to numerous peripheral operations and finally to a trigeminal extirpation without relief—a small cerebello-pontine tumor having been the cause of the discomforts from the beginning—makes this a third possible source of diagnostic error which must hereafter be carefully excluded.

Now, after skimming this variety of subjects which have happened to be momentarily of live interest to me, I am conscious that a selection of topics possibly of more general interest might have been crowded into the pages of this address, in which I should have liked, too, to pay generous tribute to those whom I recognize as my own chief examples in general methods of work—Kocher, Sherrington and Halsted—and, fully conscious of the personal note which has been struck, to the many like Horsley, Krause and Chipault who have played and will long continue to play, I trust, a far more important rôle than I can aspire to in this special field.

There is no question but that a training for neurological surgery must come through laboratory experiences, and just as we are indebted to experimentation on the lower animals for almost every fact of importance which has made for the advance of this particular department, so also must we call upon them for the mere practice of hand essential to success in their clinical applications. Those who oppose the employment of animals for such purposes would leave us the only alternative of subjecting our fellow-man, as a lesser creature, to our first crude manipulations.

In work upon the central nervous system many of the principles are widely different from those applicable to other organs of the body and cannot justifiably be put into practice except under the most favorable hospital environment. Even then the primary interest of a single individual can do little without the concentration of effort of an unshifting group of laboratory-trained associates who possess "an infinite capacity for taking pains" in both clinic and operating room. Without the coöperative devotion to this work of G. J. Heuer, S. J. Crowe and Emil Goetsch any personal efforts toward meeting the many problems which daily confront us would have been entirely unavailing, and the operative procedures themselves have often been saved from disaster by Dr. Davis' skillful handling of the anæsthetic.

Neurological surgery is fascinating, and will long continue an important and profitable field for intensive cultivation, partly because it has been largely unworked from an operative standpoint, partly because it deals with one of the two most important systems of the body—nervous and circulatory. It is gratifying to see that a number of young men are fitting themselves to specialize in it, with a preparation which makes envious one who has wriggled into the subject and, like the proverbial squid, has left little but a trail of ink behind him.

THE CAMMIDGE TEST IN EXPERIMENTAL PANCREATITIS AND OTHER CONDITIONS.

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A comprehensive discussion and analysis of the observations and experiments of the numerous writers who have made contributions to this subject would be of interest but does not seem to come within the scope of this paper. We may refer to recent publications of Hess, Hagen, Elösser, Kinnicutt and Edsall where may be found excellent reviews and discussions of the whole question and its extensive literature. It is interesting to note how varied are the tones of different writers ranging all the way from the extreme optimism of Cammidge, Mayo-Robson, Watson and Barker to absolute pessimism of Haldane, Hess, Róth, Grimbert and Bernier. We are particularly interested in the reports of different investigators who have studied the urine of animals in which pancreatic injury had been produced and we may review briefly some of these reports which vary in such an amazing degree.

Elösser performed experiments to support the theory of Cammidge that the reaction in the urine is due to the splitting of body fat into fatty acids and glycerine (fat necroses). He injected glycerine diluted with salt solution into the peritoneal cavities of two dogs. Both animals, after the injection, gave a positive Cammidge test, but he makes no note that the urine of these dogs was examined before the injection, and it is possible in the light of other experiments, that controls would have been positive. Cammidge tests "A" and "B" were used.

Schmidt reports a valuable series of animal experiments and among other things states that intraperitoneal glycerine injections do *not* cause a positive Cammidge test. He produced experimental pancreatitis by ligating or crushing the gland or by injecting oil into the parenchyma. The urine of

these animals before operation was negative, but usually positive for a few days after the injury. He gives no record of the pathology (gross or microscopical) of the cases tested, and does not test the urine for a space of more than one week. Surely if the test is specific for chronic pancreatitis, we should expect a positive test during many weeks or months following the acute pancreatitis. Our experiments indicate that an acute pancreatitis is always followed by a definite chronic interstitial pancreatitis which is constant and permanent, at least for months. Schmidt found a positive Cammidge test following resolution of pneumonia, peritonitis, and experimental injury to the liver. He believes that the reaction of the urine is due to a pentose formed by *nuclear destruction* in the pancreas or any other body tissue. It may be noted at this point that Watson found a strikingly positive Cammidge reaction in cases of pneumonia and malaria; but he is very enthusiastic about the test and considers it to be of great diagnostic value in pancreatitis. These observations agree with some of ours given below where it is evident that there is extensive cell destruction in the body (see chloroform liver necrosis) and in such conditions a positive Cammidge test is the rule.

Eichler and Shirokauer report an excellent series of experiments on dogs. They produced pancreatitis by ligating or crushing the gland. The urinary findings were very carefully studied, and the pathological findings noted at the end of each experiment—a matter of one or two weeks. Every animal gave a negative Cammidge test before operation and many gave the same negative test after the pancreas had been injured. In some experiments the urine gave a positive test for a few days following the pancreatic insult, then a negative test for 3-4 days and again a positive period of several days. The writers are skeptical about the value of the test.

It is interesting to note that different observations on the melting point of the Cammidge crystals vary as widely as do the reports on the urinary findings in men and animals. Cammidge claims that the crystals isolated by his method from the urine of men or dogs suffering with pancreatitis melt sharply at 178-180° C. and concludes that it is a pentosazone. Grimbert and Bernier give the melting point of the crystals as 137-138° C. and state that they can be obtained from normal urine. Caro and Wörner give the melting point as 150-160° C. They study the parabromphenylhydrazine as well and conclude from their analyses that the substance is a glycuronic acid. Goodman gives the melting point as about 155° C. and is in accord with Caro and Wörner. Ellenbeck gives the melting point as variable (163-184°), in different cases and believes that this indicates a relation to the pentoses and glycuronic acid.

A review of these reports would indicate that the different workers were examining different substances or perhaps a compound of many substances in which the constituents varied under different conditions. Grimbert and Bernier are of the opinion that the test is valueless because of its presence in normal urine. They believe that the form and type of the crystals are dependent upon the concentration of the solutions and the salt content. Our experience confirms this in part, and we believe that the ease with which the acid dissolves the crystals depends in great measure upon the delicacy of the crystals. If we can modify the morphology of the crystals by changing the concentration of the solution, the salt content and the rapidity of cooling we thus modify the solubility of the crystals. But the solubility in 33 per cent sulphuric acid is considered of diagnostic value (Cammidge). Schumm and Hegler state that the solubility of the crystals in acid is not in any way specific, and they believe that the majority of the positive tests are due to a small amount of grape sugar which is present in the urine but in insufficient amount to give a Fehling's test.

These facts do not tend to strengthen one's faith in this test as the essential substance does not seem to be a definite chemical entity or if so has not been isolated in a satisfactory manner.

It is interesting to review some recent experiments of Speese and Goodman which differ in some degree with the findings in our series of experiments. In their first communication they state that normal men, dogs, and rabbits never give a positive Cammidge test, but in a second paper they state that one normal dog in the 17 examined gave a positive test. They say that this dog was discarded as of no value for their experiments, but we feel that it would have been of interest to follow that normal animal to determine how long the reaction persisted in his urine. We are convinced from our own experiments that repeated observations on animals before the production of experimental pancreatitis will show that a higher per cent of normal animals give a positive Cammidge test. A critical review of the experiments of Speese and Goodman does not convince one that they are justified in their conclusion—"The Cammidge reaction is a constant feature of hemorrhagic pancreatitis, in mechanical injuries of the gland (crushing of the tail, partial extirpation) and in total extirpation."

In a recent communication Cammidge has reported some observations on animals which are in harmony with his observations on human cases. It is very easy to criticise this series of experiments, and requires but little space as he reports observations on a few animals in a rather incomplete manner. The pancreatitis was produced in a foreign laboratory by injection of turpentine into the gland or by passing a ligature into the pancreatic duct. No careful protocols of the experiments are given. The urine was sent a considerable distance in bottles preserved with toluol. Cammidge found the tests to be uniformly positive and to resemble in every way those made in human cases. The crystals were similar and the melting point identical (178-80° C.).

METHOD.

The method used in this series of experiments is that described by Cammidge as "Test C." The tests have been made by four different workers, B. S. Chaffee, R. F. Fisher, Dr. J. H. King and Dr. G. H. Whipple. Often duplicate tests were made by two or more of these workers, and every effort was made to eliminate the personal equation. The crystals were examined by the different workers and the opinions compared, the solubility

tested with 33 per cent sulphuric acid, and the types of crystals described in the histories. The tests were done carefully, and it was found that they were rather time-consuming. No difference was noted between clean, filtered cage urine and catheterized urine, but the latter was used when available. The filtered urine was freed from albumen and sugar, if necessary, and 20 cc. were taken for each test. To this is added 1 cc. of concentrated hydrochloric acid and the mixture boiled gently for 10 minutes on a sand bath in a small Erlenmeyer flask with a funnel as a condenser. The flask is then cooled and the solution made up to a volume of 20 cc. Lead carbonate (4 grams) is then added and allowed to stand for some time until all the acid is neutralized. Filter until clear. To this clear filtrate basic lead acetate (4 grams) is added to remove the glycuronic acid by precipitation. Filter until clear and add sodium sulphate (2 grams). Heat to boiling, cool and filter which removes most of the lead. 10 cc. of this clear filtrate is diluted to 17 cc. with distilled water and to it is added sodium acetate (2 grams), phenylhydrazine hydrochlorate (0.8 gram) and 1 cc. of 50 per cent acetic acid. This mixture is placed in a small Erlenmeyer flask with a funnel as a condenser, and boiled gently for 10 minutes on a sand bath. Filter hot through a hot, moist filter, and if necessary, make up the filtrate to a volume of 15 cc. by adding a little distilled water. The Cammidge crystals come down on standing, are examined under the microscope and their solubility tested with 33 per cent sulphuric acid. The typical crystals should dissolve in a few seconds after the acid touches them, and this is held to be an important diagnostic point by Cammidge.

ACUTE AND CHRONIC PANCREATITIS.

Dog 72. MEDIUM-SIZED FEMALE FOX TERRIER. WEIGHT 20 LBS.

Nov. 13. *Injection of Bile (2 cc.) Into the Pancreatic Duct.*

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Nov. 15	Cage.	Acid.	++	—	+	
Nov. 16	Cage.	Acid.	+	—	+	
Nov. 16	Cage.	Alk.	Tr.	—	+	
Nov. 17	Cage.	Alk.	+	—	+	
Nov. 18	Cath.	Acid.	+	—	+	
Nov. 18	Cath.	Alk.	+	—	+	
Nov. 19	Cage.	Alk.	+	—	+	
Nov. 20	Cath.	Acid.	Tr.	—	+	Very few crystals.
Nov. 22	Cage.	Acid.	Tr.	—	+	Do.
Nov. 23	Cage.	Alk.	Tr.	—	—	
Nov. 24	Cage.	Acid.	—	—	+	Few crystals.
Nov. 25	Cage.	Acid.	—	—	—	
Nov. 28	Cath.	Acid.	—	—	+	Very few crystals.
Dec. 4	Cage.	Acid.	—	—	—	
Dec. 8	Operation and removal of piece of pancreas. Chronic pancreatitis.					
Dec. 13	Cage.	Neutral.	—	—	+	Little blood in urine.
Dec. 20	Cage.	Neutral.	—	—	±	Atypical crystals very resistant to acid.
Dec. 23	Cage.	Acid.	—	—	++	Perfectly typical hair-like crystals.
May 1	Cath.	Acid.	—	Faint?	—	Very few large insoluble crystals.
May 1	Cath.	Acid.		—	—	
May 17	Autopsy. Chronic pancreatitis.					
Dec. 23	Purified crystals; melting point 153-4° C.					

Nov. 13, 1909. The dog is strong and well. At 12 M. an *operation* through right rectus. The large pancreatic duct isolated and 2 cc. of pig's bile injected pretty rapidly into the duct. In a few moments a diffuse ecchymotic appearance was made out involving practically all of the pancreatic tissue, showing that the injection had been pretty uniform. After 20 minutes there were many ecchymoses throughout the greater part of the pancreas and a faintly bile-tinged oedema with swelling and increased resistance in the pancreatic tissue. There was a little bleeding around the site of injection. The abdomen was closed in layers and the animal made a good recovery from the anæsthetic.

Nov. 14. Dog appears pretty sick and no clean urine was obtained.

Nov. 15. Dog is about the same.

Nov. 16. The animal drinks a large amount of water and has passed copious, pale urine of alkaline reaction.

Nov. 17. The animal is improving definitely.

Nov. 18-20. Dog is doing very well. The abdominal wound is almost completely healed.

Nov. 22. Dog seems quite well.

Nov. 23-29. Dog is quite active and seems very well and strong.

Dec. 8. *Exploratory laparotomy.* The peritoneal cavity shows many delicate adhesions around the pancreas involving the omentum and the duodenum. These are broken through with little difficulty, and the pancreas is completely exposed and brought out in the wound for examination. It has a very abnormal appearance. It is pale, quite nodular and irregular, full of depressed scars and very firm to the touch. The gland is about one-half to two-thirds of its normal size and all parts of the parenchyma are involved in this change. There are no fat necroses to be seen nor any hemorrhage. The depressed scars have a translucent bluish appearance and are evidently due to an increase in connective tissue. A good sized piece of pancreatic tissue was removed for microscopical examination, and the abdomen closed.

Microscopical section. The lobules are pretty sharply marked out, and there is a definite increase in cellular connective tissue between the lobules, associated with the larger ducts and vessels. Some of the lobules are almost normal as regards their acinar units, but many show a very diffuse increase in fibrous connective tissue. Here the acini may be greatly distorted, either shrunken and embedded in connective tissue or dilated with pink, hyaline-like casts. In other areas are found large clumps of mononuclear cells embedded in patches of connective tissue replacing parts of lobules. In some areas are seen accumulations of large phagocytes packed full of yellow, granular, blood pigment evidently the result of a healed, hemorrhagic focus. Some of the smaller pancreatic ducts are embedded in thick, new-formed connective tissue and full of pink, uniformly staining colloid material appearing as though they were much obstructed. The gland shows definite evidence of a partially healed inflammation and may be classed as a *subacute* or *chronic pancreatitis.*

Dec. 9. The animal seems well. The wound is rather œdematous.

Dec. 11. The animal is active and well, but the wound rather swollen and may break down.

Dec. 17. Dog is quite well, weighs 20 lbs.

Dec. 23. Dog is quite normal in every respect, and is put outside in the yard.

April 4. Animal returned to cage for observation, weighs 20 lbs., is strong and comparatively healthy except for mange.

May 1. Dog again placed in cage for observation and study of urine. The animal is in good health and normal except for a bad infection with mange and rather prominent pendulous teats.

May 10. Dog dipped in a solution to cure the mange.

May 17. Dog is very sick, found lying on its side. The vagina, teats, and all the breast tissue are greatly swollen and œdematous. The tissue is red and suggests a diffuse phlegmon of the abdominal tissues. Death in the afternoon.

Autopsy shortly after death. The breast tissue shows a great deal of œdema and injection but no apparent increase in glandular tissue.

Microscopical section shows a true mixed tumor of the breast tissue with much new growth of ducts and acini together with nests of cartilage. In addition there is an acute inflammation causing a great deal of œdema of all the tissues. Leucocytes are present in the interstitial tissue and the ducts, lymphatics and blood vessels. Thorax is normal. Spleen, kidneys, liver, and gastro-intestinal tract show nothing of interest in gross or microscopically. The uterus shows a nodular, cystic condition together with hemorrhage in the mucosa.

Pancreas is deep red and translucent. The parenchyma shows a pretty uniform change, and the organ is definitely smaller than normal, but does not look as abnormal as at the time of operation. The lobulation is conspicuous, and the surface has a warty appearance. The lower arm is more involved than the upper, but no part of the pancreas has escaped. The head shows several conspicuous bluish scars where all the parenchyma has been replaced by new tissue. Much of the parenchyma is speckled with tiny opacities; some of them measuring 1 mm. in diameter.

Microscopical sections show much less change than is noted above in the tissue removed at operation. The connective tissue scars are perfectly definite but much smaller and made up of dense connective tissue with a few mononuclear cells. The acini are considerably distorted in size; many of them being small and rather compressed looking, but a good many are large and quite normal in appearance. The ducts and islands show no striking abnormality. There seems to have been some recovery during the months following the removal of the control bit of tissue, but there is a definite *chronic pancreatitis.*

Dog 81. Large, Black and White Mongrel, Female, Weight 44½ lbs.

Injection of Bile Into Pancreatic Duct.

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Dec. 22	Cage.	Alk.	—	—	+	Many typical hair-like crystals.
Dec. 23	Cage.	Alk.	—	—	+	Many typical hair-like crystals.
Jan. 6	Operation. Bile (4½ cc.) injected into pancreatic duct. Acute pancreatitis.					
Jan. 6	Cage.	Alk.	Tr.	—	+	Crystals have typical shape but dissolve slowly in acid.
Feb. 1	Operation. Bile (7 cc.) injected into pancreatic duct. Acute and chronic pancreatitis.					
Feb. 2	Cath.	Alk.	Tr.	—	—	(Urine) 200 cc. treated as described by Cammidge to obtain large amounts of crystals for melting point.
Feb. 3	Cage.	Alk.	Tr.	—	—	
Feb. 5	Cage.	Alk.	Tr.	—	—	
Feb. 10	Cage.	Alk.	+	—	±	Fine yellow crystals of typical sheaf form but slowly soluble.
Feb. 28	Cage.	—	—	—	—	
May 1	Cath.	Acid.	—	—	±	Burs of very fine needles which dissolve slowly.
May 2	Cath.	Acid.	—	—	+	Large amount of fine needles and some coarse crystals.
June 30	Autopsy. Extreme chronic pancreatitis.					

Dec. 18. Operation at the root of the neck to establish a thoracic duct fistula. The operation was unsatisfactory and the animal was allowed to recover.

Dec. 19-21. The neck wound is granulating and the animal is quite active.

Dec. 22-25. Dog is noisy and active as usual.

Jan. 6. The neck wound has completely healed. The animal is quite strong and very active. *Operation* through the right rectus with exposure of the larger pancreatic duct. 4½ cc. of pig's bile were injected slowly into the pancreatic duct. Hemorrhagic specks and bile-stained œdema appeared in a few moments indicating a rather uneven distribution of the bile in the pancreas. The head and middle portions of the lower arm of the pancreas show extensive hemorrhages and marked œdema, but the upper arm shows relatively little involvement. The abdomen is closed in the usual way.

Jan. 7. Animal does not seem very sick. There is no vomiting and appetite is good.

Jan. 8. Dog is very active and hungry. The wound is clean and healing well.

Jan. 9. Animal has scratched a part of the wound, tearing it open down to the muscular layer.

Jan. 11. Dog is quite well, and the abdominal wound is granulating in a healthy manner.

Jan. 14-18. Dog is quite well.

Feb. 1. Ether anæsthesia, 10.30 a. m. *Operation.* The abdominal cavity shows many dense adhesions around the head of the pancreas and duodenum. The pancreatic duct is exposed as before, but much bleeding is encountered. The head and lower arm of the pancreas presents a very pale, nodular appearance, and is hard and resistant to the touch. There is evidently a well-marked *chronic pancreatitis.* 7 cc. of pig's bile injected rapidly into the pancreatic duct. In a few moments ecchymoses and œdema appear all through the head and lower arm of the pancreas. The upper arm is not visible and no attempt was made to release the dense adhesions between it and the lower curvature of the stomach. The abdomen is closed as usual.

Feb. 2. The animal is not especially shocked. There is no vomiting. A large amount of water is consumed and a corresponding amount of clear urine obtained by catheter.

Feb. 3. The animal is much the same.

Feb. 4. The animal is doing well and recovering rapidly.

Feb. 6. Dog appears quite normal.

Feb. 14. Dog is very noisy and active. The abdomen has completely healed, and the animal is put in the yard.

Feb. 28. Animal returned to cage for observation and seems normal in every way. Cammidge test negative.

April 27-30. Animal again in cage under observation, and appears normal. Urine obtained by catheter for Cammidge test.

May 1-June 15. Animal is under observation in cage and seems quite normal. Feces are abundant and appetite vigorous.

June 30. Dog weighs 42 lbs., and is perfectly well. Killed with ether and bleeding. *Autopsy* at once. There are many old adhesions all about the duodenum binding it to the liver and adjacent structures. Dense adhesions are present over all parts of the pancreas, and it is dissected free with some difficulty. The fat in the omentum is well preserved and quite normal. *Pancreas.* The gland is reduced to a nodular cord of tissue not over ¾ cm. wide in any part and about ⅛ cm. thick. The tissue as a rule is tough, elastic and has a bluish translucence as though connective tissue were a dominant element. There are small nodules of pale, opaque, grayish tissue which resemble gland parenchyma, but are very firm and elastic. These nodules are inconspicuous, and the larger ones which are situated in the head of the pancreas do not exceed ⅔ cm. in diameter. The blood vessels and ducts are thick and conspicuous.

Microscopical sections. The greater part of the gland is replaced by very dense scar tissue in which the distorted and thickened pancreatic ducts are embedded. Here and there are small nests of cells which may be distorted acini or islands of Langerhans. There are a few spherical nodules which are widely separated and surrounded by a capsule of scar tissue, in which the acini and islands are fairly well preserved and recognizable. Even in the best preserved nodules there is an abundance of connective tissue which distorts the acini and obscures the gland units. The healing has been complete and there are no pigment bearing cells which may mark out the areas of hemorrhage in the gland. This is a picture of *extreme chronic pancreatitis.* The stomach and intestines are greatly distended with partly digested food and the rectum is distended with pale, fatty, fecal material.

To review briefly these two experiments (dogs 72 and 81) it is clear that both animals were suffering primarily from acute hemorrhagic pancreatitis induced by the injection of bile into the pancreatic duct and secondarily from a chronic fibrous pancreatitis resulting from the healing of the acute inflammatory process. The pathological changes have been controlled by inspection at operation, microscopical examination and autopsy. Both animals were under observation for a considerable time with varying results. Dog 72 gave a constant Cammidge test during the acute stage, but the test was uncertain or absent as the lesion became more chronic. Dog 81 gave a *positive* test when in perfect health before the operation, but gave a *negative* Cammidge on several occasions after the pancreas had been injured. *Autopsy* of dog 81 revealed an extreme grade of chronic fibrous pancreatitis.

Dog 84. Active Fox Terrier, Female, Weight 16¼ lbs.

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Dec. 29	Cath.	Acid.	—	—	—	Few coarse crystals.
Jan. 11	Cage.	Acid.	—	—	—	Many fine crystals resistant to acid.
Jan. 12	Cage.	Acid.	—	—	—	
Jan. 13	Cage.	Acid.	—	—	—	Meat diet—300 grams daily.
Jan. 14	Cage.	Acid.	—	—	—	
Jan. 15	Cage.	Acid.	—	—	—	
Jan. 18	Cage.	Acid.	—	—	—	
Mar. 10	Operation. Bile (5 cc.) injected into pancreatic duct.					
Apl. 19	Operation and removal of piece of pancreas. Extreme chronic pancreatitis.					
May 1	Cath.	Acid.	—	F'nt +	—	Fine, grass-blade type of crystal in very small amount, soluble in one minute.
May 1	Cath.	Acid.	—	F'nt +	—	

Jan. 11-18. Animal on uniform meat diet—300 grams of lean meat daily.

Jan. 25. Weight 19 lbs. Animal is in excellent condition.

March 4. Weight 19½ lbs. Animal is quite well.

March 10. *Operation* through right rectus. The pancreatic duct was exposed and 5 cc. of pig's bile injected rapidly into it. Numerous ecchymoses appeared at once in all parts of the pancreatic parenchyma, but more numerous in the lower arm and head of the gland. Bile-stained œdema was conspicuous 5 minutes later. In the afternoon the animal was greatly shocked; repeated vomiting.

March 11. Animal is very sick, vomiting repeatedly and will not eat.

March 12. Dog is very sick and rather dull, vomiting repeatedly. Abdominal wound is dry and healing well. Water introduced into the stomach by a stomach tube was vomited at once. Very little urine obtained by catheter for the study of ferments.

March 13. Dog shows slight signs of improvement. Diarrhœa is a conspicuous feature, the feces yellow and fatty in appearance with a little admixture of blood. Abdomen is very tender to palpation, but wound is healing well.

March 14. Animal improved and taking food. Diarrhœa still present and of the same type as described above. Urine very scanty and high colored.

March 16. Improvement slow and animal walks about the cage well. Diarrhœa persists.

March 17. Dog looks pretty well, weighs 15 lbs. Wound practically healed. Urine abundant, clear and pale.

March 24. Animal is quite well and active and has a very vigorous appetite, but is losing weight—weighs 13½ lbs. Feces are very abundant, cream yellow and pasty.

April 4. Weighs 14½ lbs. Stools are very abundant, pale and fatty looking. Appetite is ravenous and animal will eat anything placed before her in almost any amount.

April 19. *Operation.* The abdominal cavity contains many old adhesions about the head of the duodenum binding all the structures together. There is considerable bleeding due to separation and tearing of these adhesions. The pancreas is exposed with difficulty and presents a very remarkable appearance. It is greatly distorted and practically no normal tissue is to be made out. There is only one small piece of pancreatic tissue in the head which has approximately a normal appearance. This nodule measures about 1½ cm. in long diameter. Here the pancreatic lobulation can be made out, and the parenchyma is very opaque and grayish. The remaining part of the pancreas is represented by a flat fibrous band. The tissue is very flabby and can scarcely be palpated. It resembles the tissue found after ligation of the pancreatic duct where the pancreatic tissue has undergone extreme atrophy. A small piece is removed from the lower arm close to the nodule of parenchyma described. The tissue is very tough and elastic, and in gross the parenchyma is very inconspicuous or almost absent.

Microscopical sections. The tissue is very difficult to cut owing to the fact that it is made up in great part of dense, fibrous tissue. The sections show an extreme grade of *chronic pancreatitis.* There is no normal parenchyma to be seen. A few small islands of pancreatic tissue are left embedded in dense connective tissue. The islands are inconspicuous and greatly distorted, but the acini have suffered much more and scarcely a normal acinus is visible. They are all distorted and embedded in connective tissue full of mononuclear cells. In places there are huge nests of phagocytes containing yellow granular pigment, the results of hemorrhage during the acute stage. Even the collecting ducts of the pancreas are greatly distorted, narrowed and embedded in dense scar tissue.

April 20. Animal is well and wound healing perfectly.

May 1. Animal is quite well. Feces are abundant and fatty, and the appetite is ravenous.

June 9. Condition remains the same. Weighs 17 lbs.

This animal (dog 84) is of considerable interest for several reasons. Repeated observations under fixed conditions and uniform diet gave no Cammidge test before operation. Injection of bile into the pancreatic duct caused a severe pancreatitis which almost resulted fatally and which in healing produced an *extreme chronic pancreatitis.* The dog clinically showed all the signs of advanced chronic pancreatitis, abundant fatty stools, huge appetite and low carbohydrate tolerance. Removal of a piece of pancreatic tissue demonstrated an extreme grade of chronic fibrous pancreatitis in microscopical sections. Yet observations during this period gave a *negative* Cammidge test (see chart 84).

Nov. 3. *Operation* through right rectus and isolation of pancreatic duct. 1½ cc. of pig's bile was injected into the pancreas with a pretty uniform distribution as indicated by the ecchymoses.

Nov. 4. Dog is not very sick, no vomiting.

Nov. 5. Animal appears practically well.

Nov. 24. Dog is quite well and active. *Operation* and removal of some pancreatic tissue at the end of the lower arm. The upper limb and head of the gland appeared a little more nodular, paler and firmer than normal, but the piece removed was very firm and nodular in appearance.

Dog 67. Small Fox Terrier, Male, Weight 14 lbs.
Nov. 3. *Injection of Bile (1½ cc.) Into Pancreatic Duct.*

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Nov. 3	Cage.	(?)	(?)	—	—	Before operation.
Nov. 4	Cage.	Acid.	—	+	+	
Nov. 10	Cage.	Acid.	—	—	+	
Nov. 11	Cage.	Acid.	—	—	+	
Nov. 12	Cage.	Acid.	—	—	+	
Nov. 15	Cage.	Acid.	—	—	—	
Nov. 24	Cage.	Acid.	—	—	—	
Nov. 24	Operation. Removal of piece of pancreas. Subacute pancreatitis.					
Apl. 16	Operation. Removal of second piece of pancreas. Normal (?)					
May 1	Cage.	Acid.	—	—	±	Very small amount of crystals, irregular burs of long hair-like form soluble in 30 seconds.
June 27	Autopsy. Slight chronic pancreatitis.					

Microscopical section. There is an advanced grade of chronic diffuse pancreatitis together with some acute inflammation. The pancreatic acini are distorted and separated from each other by a very cellular connective tissue full of mononuclear cells of all types. There are also phagocytes full of yellow, granular pigment. The interlobar tissue is very œdematous and full of blood-vessels and young fibroblasts with some recent areas of hemorrhage in some places. The pancreatic duct is relatively less affected but embedded in masses of scar tissue in some areas.

Dec. 4. Animal has recovered from the operation perfectly.

Dec. 11-March 13. Animal in yard and quite well.

April 16. Weight 20 lbs. Operation as before and removal of the second piece of pancreas. The gland appears more nearly normal than at first operation, except for the presence of many dense adhesions at the site of former operations.

Microscopical section. The gland tissue is almost normal. There are a few small connective tissue scars here and there in some of the lobules, but practically all the acini are normal in every respect.

May 1. Dog is quite well. Urine obtained in large amount for the Cammidge test was practically negative.

June 27. Dog is in perfect health—weight about 20 lbs. Killed with ether. *Autopsy* at once. There are many dense adhesions around the duodenum. Thorax: heart and lungs are all normal. Spleen, stomach, intestines, kidneys and liver are perfectly normal. *Pancreas:* almost all of the lower arm has been removed and only a bit of it close to the duodenum remains embedded in a mass of adhesions. This pancreatic tissue is firm, nodular and pale but the parenchyma of the head and upper arm shows much less change. Much of the gland here is normal, but there are areas here and there where it is evident that there is an increase in scar-tissue. These areas are more nodular and appear as depressions in the gland tissue and are tougher than the normal pancreas.

Microscopical sections show a slight grade of chronic pancreatitis. The connective tissue is conspicuous around some of the smaller ducts and in some of the lobules in these areas there are small scars, but the acini as a rule are normal.

Nov. 15. *Operation* through right rectus and resection of a greater part of the pancreatic gland. About 4 cm. of the distal portion of the lower arm of the pancreas was left in situ. A few small bits of pancreatic tissue close to the duodenum were not removed.

Nov. 16. Animal is doing well. Urine shows a trace of albumen and some sugar.

Nov. 17. Sugar has disappeared from the urine, and its presence was undoubtedly explained by the long anæsthesia of the preceding day.

Dog 73. Small, Female, Fox Terrier, Weight 10¾ lbs.
Nov. 15. *Resection of Part of Pancreas.*

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Nov. 18	Cage.	Acid.	Tr	—	—	
Nov. 21	Cage.	Acid.	—	—	—	
Nov. 23	Cage.	Acid.	—	—	—	
Dec. 13	Cage.	Acid.	—	—	+	Typical crystals.

Nov. 18-23. Animal is quite well. Urine shows no sugar.

Nov. 24-30. Animal is slowly losing weight. The urine contains no sugar. The feces are very abundant, fatty and the appetite enormous.

Dec. 6. Animal given 10 grams of cane sugar dissolved in 100 cc. of water by mouth.

Dec. 7. Urine contains no sugar. The dog again given sugar, 30 grams, dissolved in water. Urine obtained in the afternoon contained sugar.

Dec. 8. Weight 8¾ lbs. Urine contains no sugar.

Dec. 16. *Operation* through right rectus for exploration. The remnant of the pancreas is closely adherent to the wall of the duodenum and the liver by dense adhesions. It is very pale and nodular, measuring about 2½ x 1 x ⅓ cm. A small piece was removed for microscopical section.

Dec. 17-18. Animal recovering rapidly from operation.

Dec. 20. Dog found dead in cage.

Autopsy. The peritoneum showed no acute inflammation. Thorax, heart and lungs negative. Spleen and liver were normal. The other viscera were negative except the pancreas.

The *pancreas* remnants were removed entire, adherent to the duodenum. Microscopical sections show an advanced grade of chronic diffuse pancreatitis throughout all the parenchyma. The lobules of the gland are separated by dense bands of connective tissue. The acini are quite abnormal, embedded usually in a rich stroma of connective tissue and mononuclear cells; some of them seem relatively normal. The collecting tubules are rather inconspicuous, but some of them contain organized casts of a hyaline nature.

Dog 60. Mongrel, Female, Weight 17 lbs.
Oct. 26. *Injection of Bile (¼ cc.) Into Pancreatic Duct.*

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Oct. 27	Autopsy.	Acid.	+	—	+	Abundant typical crystals.

Oct. 26. *Operation* through right rectus and injection of 4 cc. of fresh pig's bile into the pancreatic duct. Immediately hemorrhages appeared throughout the gland and there was an intense œdema. Wound closed in the usual manner. Animal was very sick in the afternoon.

Oct. 27. Animal is moribund. Killed with ether. *Autopsy* at once. The peritoneal cavity contains about 40 cc. of blood-tinged fluid, and the serous surfaces everywhere are greatly injected. The urine used for Cammidge test was obtained from the bladder at autopsy and gave very typical sheaves of crystals. The viscera except for the pancreas show no lesions of interest. The *pancreas* is very large, firm and œdematous, and about twice the normal size. It is speckled over with fat necroses which are present as well in the nearby fat. The pancreatic tissue is mottled with hemorrhagic splotches. Some of the tissue in the head of the gland is green, opaque and necrotic looking.

Microscopical section shows a typical picture of acute hemorrhagic pancreatitis with much fat necrosis and hemorrhage.

DOG 64. MEDIUM SIZED MONGREL, FEMALE.
Nov. 2. *Injection of Bile (2 cc.) Into the Pancreatic Duct.*

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Nov. 3	Cage.	Acid.	—	—	+	

Nov. 2. *Operation* as usual and injection of 2 cc. of pig's bile into the pancreatic duct. The injection entered the head and a part of both arms as shown by the ecchymoses and bile-stained œdema which appeared in a few moments.

Nov. 3. Animal sacrificed for class demonstration with autopsy. The peritoneal cavity contains some blood-tinged fluid and shows a beginning peritonitis. The viscera are negative except for the pancreas. The *pancreas* is large, firm, œdematous, and presents a mottled appearance, the gland tissue being of a pinkish color, mottled over with many small ecchymoses. There are numerous large chalky fat necroses. On section hemorrhages are found to be much more numerous in the core of the gland, close to the ducts than in the parenchyma just under the peritoneum. The distal half of the lower arm has escaped much of this acute process and looks relatively normal.

The last three experiments are incomplete and rather unsatisfactory: they were early experiments and not carefully controlled by observations before operation. It is interesting to note that dog 73 gave no Cammidge test shortly after resection of most of the pancreas but gave a positive test a month later, shortly before the death of the animal. *Autopsy* showed chronic pancreatitis in the remaining bit of pancreas. Dog 67 gave a positive test during the acute period of the disease but a negative test latter, when operation revealed a subacute pancreatitis. This experiment seems to give some evidence that the pancreas can recover from a sub-acute condition and return almost to normal.

CHLOROFORM LIVER NECROSIS.

DOG 58. LARGE BLACK MONGREL, MALE, WEIGHT 27 LBS.
Oct. 22. *Injection of Chloroform Into Portal Vein.*

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Oct. 25	Cage.	Acid.	—	—	+	
Oct. 26	Cage.	Acid.	—	—	+	
Nov. 29	Second operation. 1 cc. chloroform injected into portal vein.					
Nov. 30	Floor.	Acid.	—	—	—	
Dec. 1	Floor.	Acid.	—	—	+	
Dec. 2	Cath.	Acid.	—	—	+	Urine obtained from bladder at autopsy.

Oct. 22. *Operation* through right rectus and injection of 1 cc. of chloroform (undiluted) into portal vein.

Oct. 23. Animal rather sick, but will eat.

Oct. 24-30. Rapid improvement to normal.

Nov. 2-16. Dog is quite active and well in the yard.

Nov. 29. Second *operation* identical with the first.

Dec. 2. Animal has torn the wound open permitting escape of intestines. Killed with ether. *Autopsy* at once. The peritoneal cavity shows considerable injection, and a little fresh peritonitis over the areas of damage in the liver parenchyma. Heart, lungs, thorax, spleen, intestine are all normal. Pancreas shows a little injection in some places, but there are no fat necroses and no hemorrhages. Liver is very large and swollen. There are a few depressed bluish scars evidently the result of the first injection. There are extensive areas of complete necrosis of the liver tissue which appear as greenish gray, opaque areas surrounded by a thin zone of hemorrhage. The liver tissue everywhere is very deep purplish red and friable. The areas of necroses show a haphazard distribution.

Microscopical sections. Pancreas, spleen, and other organs show nothing of importance. The *liver* shows many connective tissue scars which are relatively inconspicuous and in all instances situated about the portal tissue causing a certain amount of distortion of the nearby lobules. There is some proliferation of bile-ducts but this is relatively inconspicuous. In addition there are large and small, hyaline necroses affecting all parts of the liver. Some of the larger areas measure several centimetres in diameter, and present a uniform, hyaline appearance in the center with a margin of inflammatory tissue. There are smaller discrete, hyaline necroses involving one or more lobules or only a part of a single lobule. Here the liver cells present a hyaline appearance and are associated with many mononuclear and polymorphonuclear cells. The blood-vessels are injected in these regions. The areas of necrosis are usually intimately associated with the portal spaces.

DOG 87. BULL TERRIER, FEMALE, WEIGHT 18½ LBS.
Jan. 25. *Chloroform Anæsthesia.*

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Jan. 27	Cage.	Acid.	+	—	+	Albumen removed.
Jan. 27	Cage.	Acid.	+	—	+	Albumen not removed.
Jan. 27	Operation and removal of piece of liver. Central necrosis and fatty degeneration.					

Jan. 25. *Chloroform anæsthesia* for *2 hours*, ⅘ of an ounce of chloroform used. Anæsthetic was well taken. At the end of anæsthesia the animal was bled 75 cc. from the jugular and infused with 200 cc. of normal saline plus 2 grams of calcium lactate.

Jan. 26. The animal is recovering rapidly.

Jan. 27, 10.30 a. m. *Operation* and removal of a small, wedge-shaped piece of liver with closure in the usual manner.

Microscopical sections. There is relatively little necrosis of the liver cells in the very center of each liver lobule, but a great deal of fatty degeneration affecting the central ⅔ of each lobule. The liver cells are filled with large and small fat droplets and are extensively damaged. There are many polymorphonuclear leucocytes invading these areas.

Jan. 28-30. Animal recovering slowly.

Feb. 17. Dog is quite well and weighs 21 lbs.

DOG Q. LARGE MONGREL, FEMALE, WEIGHT 21½ LBS.
Dec. 3. *Chloroform Anæsthesia.*

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Dec. 4	Cage.	Acid.	Tr.	—	+	
Dec. 5	Cage.	Acid.	Tr.	—	+	
Dec. 6	Cage.	Acid.	Tr.	—	+	
Dec. 6	Death. Chloroform poisoning.					

Dec. 3, 2 p. m. *Chloroform anæsthesia* for *2¼ hours*. 1 oz. of chloroform given. Muscular tremors were marked during the anæsthesia. At the end of this period the animal was bled 120 cc. of blood and 150 cc. of normal saline infused. The animal recovered rapidly after the anæsthesia and seemed in good shape.

Dec. 4. Animal seems well. There is no vomiting.

Dec. 5. Dog is quiet but seems pretty well. *Operation* through

right rectus and removal of a wedge-shaped piece of liver. The wound is closed as usual.

Microscopical section shows every lobule to be extensively damaged. The central half shows almost complete hyaline necrosis with invasion by many wandering cells. The middle zone of liver cells shows many large fat droplets. The animal bled to death that night.

Dec. 6. Autopsy. The abdominal cavity contains a large amount of fluid blood. The surfaces are smooth. Thorax, heart, lungs, spleen and gastro-intestinal tract are all normal. *Pancreas* is very pale. The lobulation is uniform. There are no necroses nor hemorrhages.

The *liver* presents the usual appearance seen in chloroform poisoning. The centers of the lobules are very conspicuous, bright red, and the margins are swollen, opaque and yellowish. The capsule is tense, and the tissue is very friable.

Microscopical section. The spleen, kidney, and pancreas are quite normal. The liver shows practically the same condition described above.

Dog R. Small Fox Terrier, Female, Weight 10 lbs.
Dec. 3. *Chloroform Serum (Dog Q) Injected Intravenously.*

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Dec. 4	Cath.	Acid.	Tr.	—	+	
Dec. 5	Operation. Removal of piece of liver. Normal microscopically.					
Dec. 6	Cath.	Acid.	—	—	+	
Dec. 11	Cath.	Acid.	—	—	+	

Dec. 3. The blood obtained from dog Q was defibrinated, filtered through gauze, centrifuged and 50 cc. of clear serum obtained with aseptic precautions. Under ether anæsthesia dog R was bled 50 cc. from the jugular, and the 50 cc. of blood serum from dog Q was given intravenously. Dog R was under anæsthesia 30 minutes and recovered rapidly with no apparent ill effects.

Dec. 4. Animal is quite well. Urine is normal.

Dec. 5. Animal appears perfectly well. *Operation* through the right rectus with removal of a small, wedge-shaped piece of liver.

Microscopical section. There is absolutely no liver necrosis. The liver cells contain no fat droplets nor do they show any evidence of injury. There is an apparent increase in polymorphonuclear leucocytes in the capillaries in various parts of the liver lobules. Occasionally many of them will be found in the periportal tissue, but there is no regular distribution and no remarkable increase in number.

Dec. 6. Dog is active and quite well, and appetite good.

Dec. 12. Dog is healthy and wound is granulating.

Dec. 13-14. Animal is quite well.

Dec. 16. Dog put out in the yard.

Dog S. Large Mongrel, Female, Weight 34 lbs.
Chloroform Anæsthesia and Saline Injection.

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Dec. 17	Chloroform anæsthesia 2½ hours. Bled 280 cc. Infusion intravenously 500 cc. saline.					
Dec. 18	Cage.	Alk.	Tr.	—	+	
Dec. 19	Cage.	Alk.	+	—	+	
Dec. 19	Operation. Removal of piece of liver. Chloroform necrosis.					
Dec. 20	Cage.	Alk.	+	—	+	
Dec. 20	Animal bled to death. Chloroform poisoning.					

Dog S. Dec. 17. *Chloroform anæsthesia for 2½ hours*, 1½ oz. of chloroform given. At the end of two hours the animal was bled 280 cc. from the jugular and infused intravenously with 500 cc. of normal saline.

Dec. 18. Animal feels pretty well and has passed a large amount of pale urine.

Dec. 19. No vomiting, appetite good. Dog pretty active. *Operation* through right rectus with removal of a wedge-shaped piece of liver.

Microscopical sections. Every liver lobule shows extreme central hyaline necrosis affecting at least ⅔ of the liver cells and great numbers of wandering cells have invaded these areas of necrosis. There is a thin middle zone of fatty liver cells and a thin rim of well-preserved liver cells about the portal spaces. Mitotic figures are numerous here. At operation the bleeding was very difficult or impossible to control, and it was thought that the animal might die from hemorrhage due to inefficient blood coagulation.

Dec. 20. Animal found dead in cage. *Autopsy.* The peritoneal cavity is full of fluid blood and no clots can be found anywhere. The organs in general are negative. The *pancreas* is absolutely normal. The liver shows the usual picture found in chloroform poisoning.

Dog T. Small Female Pup, Weight 12 lbs.
Chloroform Serum Injection.

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Dec. 17	Serum (120 cc.) from Dog S injected intravenously after bleeding 55 cc. under ether.					
Dec. 19	Cage.	Acid.	—	—	+	Small crystals.
Dec. 19	Cage.	Acid.	—	—	—	Coarse insoluble crystals.
Dec. 19	Operation. Removal of piece of liver. Normal.					
Dec. 20	Cage.	Acid.	—	—	+	Many typical crystals.

Dog T. Dec. 17. 280 cc. of blood obtained from dog S in a sterile manner were defibrinated, centrifuged and 120 cc. of clear blood serum obtained. Dog T was bled 55 cc. from jugular under ether anæsthesia and infused intravenously with 120 cc. of blood serum from dog S. Ether anæsthesia for 15 minutes. Animal recovered rapidly and appears quite well.

Dec. 18. Animal is quite well.

Dec. 19. Dog is well. Urine is pretty high colored and contains indican. Cammidge positive from one specimen of urine and negative in another during this same day. *Operation* through right rectus and removal of wedge-shaped piece of liver. Wound closed in the usual manner.

Microscopical section. The liver presents a normal picture in every respect. There are no fat deposits in any of the liver cells and no evidence of necrosis. Evidently the injection of this large amount of serum from an animal poisoned with chloroform had no ill effects.

Dec. 21-25. Dog recovering rapidly from the operation.

Dog O. Male Pup, Weight 14 lbs.
Nov. 12. *Chloroform Anæsthesia—Bleeding and Saline Infusion.*

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Nov. 14	Cath.	Acid.	—	—	—	Urine from bladder at autopsy.
Nov. 14	Autopsy. Little liver necrosis but central fatty degeneration. Pancreas normal.					

Dog O. Nov. 12. *Chloroform anæsthesia for 2 hours*, ¾ ounce of chloroform used. After the first hour of anæsthesia the animal was bled 50 cc. from the jugular and infused intravenously 75 cc. of normal saline.

Nov. 13. Animal is quite well, no vomiting.

Nov. 14. Some bleeding from vessels of neck. Animal is killed with ether.

Autopsy. The viscera are negative except the liver. The *pancreas* is quite normal in gross and in microscopical sections.

Liver is large and swollen. The lobulations are conspicuous, and the centers are opaque and yellowish.

Microscopical sections. The liver lobules are relatively little affected. In the centers of the lobules one finds a few necrotic liver cells associated with many polymorphonuclear leucocytes. The central half of each lobule shows a large amount of fatty degeneration, and the cells contain large and small fat droplets.

Dog P. FOX TERRIER, MALE, WEIGHT 14 LBS.

Nov. 19. *Chloroform Anæsthesia—Bleeding and Saline Infusion.*

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Nov. 20	Cage.	Acid.	+	—	+	
Nov. 21	Cath.	Acid.	+	—	+	Urine from bladder at autopsy.
	Autopsy. Little liver necrosis but much central fatty degeneration. Pancreas normal.					

Dog P. Nov. 19. *Chloroform anæsthesia* for *2 hours*, ½ oz. of chloroform used. During the last 15 minutes of anæsthesia the animal was bled 70 cc. from the jugular and infused intravenously with 90 cc. of normal saline.

Nov. 20. Animal seems pretty well, no vomiting.

Nov. 21. Animal killed by ether and bleeding from the carotids.

Autopsy. The viscera are negative except the liver. The *pancreas* is normal in every way in gross and microscopically.

Liver is larger than normal. The lobulations are sharply marked out. The central portions of the lobules are opaque. There is no evidence of necrosis. Microscopical section shows the central half of each liver lobule to be somewhat injured as indicated by fatty degeneration of the liver cells, but there is no conspicuous necrosis. A few polymorphonuclear cells are present in this region, but the liver is relatively little injured.

These experiments with with chloroform poisoning were all done in connection with other problems and the observations on the urine are somewhat fragmentary as a result, but we believe of considerable interest and importance. In these experiments the Cammidge test is almost constantly present and often more strikingly positive than in cases of pancreatitis, yet the autopsies show the pancreas to be normal. There is more or less cell injury and destruction with the appearance of great numbers of polymorphonuclear leucocytes in the liver lobules. The result of injecting pure chloroform into the portal vein is the production of scattered areas of necrosis, large and small, in all parts of the liver. The distribution is not uniform and the necroses are usually associated with periphery of the liver lobule and the portal structures. The cell reaction is practically the same here as in chloroform poisoning and there is autolysis of great numbers of degenerated cells, both liver cells and various wandering cells from the blood. The products of this cell injury and solution must appear in the blood as they are removed rapidly from the liver and we hope in another communication to bring evidence of this escape into the blood. It is probable, or almost certain, that some of these substances escape from the blood through the kidneys and appear in the urine—for example the ferment lipase and bile pigments. Possibly the substance or substances which give the Cammidge test may appear in the urine in the same way and surely are dependent upon the liver injury as this is the only constant pathological lesion in these experimental animals. It seemed possible to cause cell destruction and disintegration by artificial means—hydrolysis with acids—to investigate whether such materials introduced into the serous cavities could cause the appearance of the Cammidge test in the urine and such was found to be the case.

PNEUMONIA.

Dog 52. Mongrel, female, weight 14¾ lbs.

Oct. 11. Chloroform anæsthesia 1½ hours. 1 oz. of chloroform given.

Oct. 13. Operation and removal of piece of liver for microscopical examination. The liver presents the usual appearance. The center of each liver lobule shows hyaline necrosis of the characteristic type.

Oct. 21. Chloroform anæsthesia for 1½ hours. ¾ of an ounce of chloroform given.

Nov. 2. Dog has completely recovered and is put in the yard.

Nov. 8. Animal has distemper with considerable discharge from nose and eyes.

Nov. 12. Animal is quite sick and is placed in the cage for observation.

Nov. 13. Animal is losing ground.

Nov. 14. Animal is very sick, and there are muscular twitchings, Dyspnœa is quite marked. Urine obtained from cage shows no bile-pigment nor albumen, but a very typical Cammidge test.

CHART 52.

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Nov. 14	Cage.	Acid.	—	—	++	Typical and abundant Cammidge crystals.
Nov. 15	Cath.	Acid.	Tr.	—	+	

Nov. 15. Animal is having convulsions and is killed with ether.

Autopsy. The serous cavities, heart, spleen, gastro-intestinal tract are all normal.

Lungs. The bronchi in the lower lobes are slightly dilated and full of muco-purulent material. The posterior portions of the lungs are very œdematous and heavy, and there are scattered areas of consolidation. These areas of bronchopneumonia have a greenish, gray translucence. Some of them measure 2 cm. in diameter. This is the usual finding in fatal cases of distemper in the animals at the laboratory.

Microscopical section shows great numbers of polymorphonuclear leucocytes, but very little fibrin in the alveoli. The bronchi contain a similar exudate.

Kidneys show a few gray streaks and nodules in the cortex which under the microscope prove to be cellular scars, in some instances extending through the cortex. There are a good many casts in these areas and much distortion of the gland elements. *Pancreas* appears normal in gross, but under the microscope one finds a few very small focal necroses. They correspond to those found in human cases. The acini in these areas have partly disappeared and are replaced by connective tissue and wandering cells. These areas are not numerous nor of large size. The pancreatic acini as a rule are quite normal.

Liver. The lobulations and consistence are normal. There is an old scar at the site of the previous operation.

Microscopical sections show practically complete repair of the chloroform necrosis. The lobules are of normal size and practi-

cally all of the liver cells of normal appearance. There are a few pigmented phagocytes in the very centers of some of the lobules, all that remains of the repair which followed the chloroform necrosis. The bile ducts and the connective tissue are quite normal.

Hydrolytic Products Injected into Animals.

When it was found that animals suffering from pneumonia and chloroform poisoning gave a positive Cammidge test—in fact often a more abundant deposit of crystals than animals suffering from acute pancreatitis—it was suspected that cell destruction was a contributing factor. In order to try out this supposition, we hydrolyzed various tissues with acids—parts of pneumonic consolidation in dogs and man, thymus gland—neutralized the material and injected the clear filtrates into the peritoneal cavities of dogs. This procedure, as a rule, caused substances to appear in the animal's urine which gave the Cammidge test and these experiments afford strong evidence that the Cammidge reaction cannot be looked upon as a specific test for pancreatitis. The histories of these experiments are given in detail below.

Dog 61. Mongrel, Female, Weight 14¼ lbs.

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Nov. 23	Cath.	Acid.	—	—	—	Before injection.
Nov. 23	Injection of hydrolytic products of pneumonic lung.					
Nov. 24	Cath.	Acid.	—	—	+	Large amount of typical crystals.
Nov. 26	Cath.	Acid.	—	—	+	
Nov 27	Cage.	Acid.	—	—	+	Few crystals.
Nov. 28	Cage.	Neutral.	—	—	+	
Nov. 29	Cage.	Alk.	Tr.	—	+	
Nov. 30	Cage.	Alk.	Tr.	—	+	
Dec. 1	Cage.	Alk.	Tr.	—	+	Large amount of typical crystals.
Dec. 6	Cath.	Acid.	—	—	+	
Dec. 7	Operation. Pancreas quite normal. Lower arm ligated.					
Dec. 13	Cage.	Alk.	Tr.	—	+	
Dec. 17	Cage.	Acid.	—	—	±	Two types of crystals, one coarse, other fine, but both slowly soluble.
Dec. 19	Cage.	Acid.	—	—	+	Few small crystals.
Dec. 23	Cage.	Acid.	—	—	+	
May 1	Cath.	Acid.	—	—	+	Many typical crystals.
May 1	Melting point of these purified crystals 172° C.					

The *hydrolytic products* used in this experiment were obtained from dog 71 which died with a massive bronchopneumonia. Fifteen grams of this pneumonic consolidation were ground up and hydrolized for 2 to 3 hours with 200 cc. of 5 per cent sulphuric acid, the mixture being heated over a boiling water bath with a funnel as a condenser. At the end of this time the mixture was carefully neutralized with barium hydroxide after cooling. The clear filtrate was sterilized and used for experiment.

Dog 61. Nov. 23. Urine was obtained by catheter before the injection and found to give a negative Cammidge test. Under ether anæsthesia 65 cc. of the clear neutral filtrate (Dog 71) were injected slowly into the peritoneal cavity. The animal recovered rapidly from the anæsthesia.

Nov. 24. Animal is a little dull and has vomited.

Nov. 26. Dog looks quite well and is active as usual.

Nov. 27-Dec. 6. Appetite good. Animal active and very noisy.

Dec. 7 *Operation* and exploratory laparotomy. Digestion is going on rapidly and the lymphatics in the mesentery are dilated with milky fluid. The peritoneal cavity everywhere is normal. There are no adhesions. The *pancreas* is absolutely *normal*. It has a delicate grayish pink tint due to active digestion. Ligatures were passed around the lower arm of the pancreas close to its duodenal attachment, tied tightly, and the gland cut between them. This procedure isolated the distal portion of the lower arm of the pancreas and was done in connection with other work in progress. This piece of pancreas will undergo extensive atrophy and chronic induration.

Dec. 9-13. Animal is doing well.

Dec. 14-17. Animal is quite well, weight 11 lbs.

Jan. 25. Animal has regained weight (14½ lbs.) and is quite normal.

May 21. Animal has gained weight and is in perfect health.

Dog 77. Small Fox Terrier, Female, Weight 9½ lbs.

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Dec. 10	Cage.	Acid.	—	—	—	Before injection.
Dec. 10	Injection of hydrolytic products of thymus gland.					
Dec. 11	Cage.	Acid.	—	—	+	
Dec. 12	Cage.	Acid.	—	—	+	Typical crystals.
Dec. 17	Cage.	Acid.	—	—	+	
Dec. 19	Cage.	Acid.	—	—	±	Atypical burs of very fine crystals soluble with difficulty.
Dec. 25	Cage.	Acid.	—	—	—	Coarse insoluble crystals.
Dec. 29	Cage.	Acid.	—	—	—	
Feb. 7	Cage.	Acid.	+	—	—	Abundant amorphous deposit.

Hydrolytic products. The thymus gland from dog 71, weight 11 grams, was ground up and hydrolized with 100 cc. of 10 per cent sulphuric acid for 2 to 3 hours on water bath. The mixture was carefully neutralized with barium hydroxide, filtered, evaporated and concentrated to a volume of 80 cc. This clear filtrate had a pale amber color.

Dog 77. Dec. 10, 3 p. m. Intraperitoneal injection of 25 cc. of the material described above. Ether anæsthesia for 10 minutes. The urine obtained by catheter before this injection gave a negative Cammidge test.

Dec. 11. Animal appears rather sick.

Dec. 12. Animal is quiet and remains curled up in the cage.

Dec. 16. Animal is rather quiet, but seems normal.

Dec. 17. Animal, weight 10½ lbs., appetite good.

Dec. 29. Animal is well and weighs 11 lbs.

Jan. 25. Weight 12½ lbs.

Feb. 8. Animal is quite well and used for chloroform experiment.

Feb. 9. Animal dead. *Autopsy* at once. Viscera are of no particular interest. The pancreas is normal in every respect.

Hydrolytic Products.—The material obtained from the *thymus* gland is the same as that used in dog 77 and described there. *Pneumonic lung,* autopsy 3336. This was a human case showing massive grey hepatization. The material was obtained 17 hours after death. 250 grams of this material were cut up into small pieces and hydrolized on a boiling water bath for 7 hours with 1000 cc. of 5 per cent sulphuric acid. At the end of this time the greater part of

Dog 76. MONGREL, FOX TERRIER, FEMALE. WEIGHT 16¼ LBS.

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Dec. 6	Floor.	Acid.	—	(?)	+	
Dec. 7	Injection of hydrolytic products of thymus gland.					
Dec. 11	Floor.	Acid ?	—	—	+	
Dec. 13	Cage.	Neutral.	—	—	+	
Dec. 17	Cage.	Acid.	—	—	—	Amorphous deposit.
Dec. 22	Cage.	Acid.	—	—	+	Typical crystals.
Dec. 27	Hemolysis and resultant bile pigments in urine.					
Dec. 28	Cath.	Neutral.		(?)	—	Amorphous sediment.
Feb. 14	Cage.	Neutral.	—	—	+	Before injection.
Feb. 14	Injection of hydrolytic products of pneumonic lung.					
Feb. 15	Cage.	Faintly acid.	Tr.		+++	Enormous amount of typical Cammidge crystals in sheaves, soluble on contact with acid.
Feb. 16	Cage.	Faintly acid.	—		++	Same type of crystals.
Feb. 17	Cage.	Faintly acid.	—	—	+	Same type of crystals.
Feb. 19	Cage.	Faintly acid.	—	—	+	Same type of crystals.
Feb. 23	Cath.	Faintly acid.	—	—	—	Fine crystals in burs, soluble in 3 minutes.

the material was in solution. The mixture was neutralized with great care with barium hydroxide, filtered and concentrated to a volume of 500 cc., each cubic centimeter of this solution containing the extractives and cleavage products from ½ gram of lung tissue. The material obtained was a clear whiskey colored fluid which was sterilized and preserved for further use. The *Cammidge test* performed on this material shortly before injection gave a beautiful test. Great numbers of crystals appeared in the test tube. These crystals were very delicate and hair-like, arranged in sheaves and dissolved immediately on contact with acid. Several weeks later the same material after repeated sterilizations was again examined and the Cammidge test by the same worker was negative. A large amount of amorphous material came down in the test tube but no crystals.

Dog 76. Dec. 6. Animal is active and in heat.

Dec. 7. Ether anæsthesia and intraperitoneal injection of 25 cc. of the hydrolytic products from the thymus gland described above (Dog 76).

Dec. 12. Dog is active and quite well.

Dec. 27. Ether anæsthesia and injection intraperitoneally of 30 cc. of red blood corpuscles obtained by centrifuging some defibrinated blood from a normal animal.

Dec. 28. Animal is quite active and appears perfectly normal. Appetite good. *Urine* has typical appearance of "black-water." A granular brown sediment settles on standing. Test for bile-pigments are very positive. Albumen is abundant. No sugar. Cammidge test is quite negative.

Dec. 29. Urine is clearing up, but still gives test for bile pigment.

Jan. 25. Animal is quite well, weighs 18½ lbs.

Feb. 14. Dog is quite well. Ether anæsthesia and intraperitoneal injection of 20 cc. of *hydrolytic products* from the human *pneumonic lung* described above. Animal recovered rapidly from anæsthetic, but in the afternoon appears quite sick. There is a remarkable dyspnœa and vomiting. The animal appears fatally poisoned.

Feb. 15. The dog is quite well.

March 4. Animal is normal, weighs 18½ lbs.

May. Animal is normal and used for another experiment. The pancreas was resected. The gland was found to be normal in every respect.

Dog 80. FOX TERRIER, FEMALE, WEIGHT 16 LBS.

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Dec. 17	Cage.	Acid.	—	—	—	
Dec. 20	Cage.	Acid.	—	—	+	Few typical crystals.
Dec. 21	Cage.	Acid.	—	—	+	Few typical crystals.
Dec. 21	Cath.	Acid.	—	—	±	Atypical crystals.
Dec. 23	Cath.	Acid.	—	—	+	
Dec. 24	Cath.	Acid.	—	—	+	
Dec. 27	Cath.	Acid.	—	—	±	Few coarse insoluble crystals, modified by recrystallization.
Jan. 11	Cage.	Acid.	—	—	—	Milk diet.
Jan. 12	Cage.	Acid.	—	—	—	
Jan. 13	Cage.	Acid.	Tr.	+	—	Varying amounts of atypical crystals, usually in bur form and very resistant to acid.
Jan. 14	Cage.	Acid.	+	+	—	
Jan. 16	Cage.	Acid.	+	+	—	
Jan. 17	Cage.	Acid.	Tr.	++	—	
Feb. 24	Cath.	Acid.	—	—	—	Before injection.
Feb. 24	Injection of hydrolytic products of pneumonic lung (10 cc.).					
Feb. 24	Cage.	Acid.	—	—	—	3 hours after injection.
Feb. 24	Cath.	Acid.	Tr.	—	—	6 hours after injection.
Feb. 25	Cath.	Acid.	Tr.	—	—	
Mch. 2	Cath.	Acid.	—	—	—	Before injection.
Mch. 2	Injection of hydrolytic products of pneumonic lung (17 cc.).					
Mch. 2	Cage.	Faintly acid.	—	—	+	2½ hours after injection.
Mch. 3	Cath.	Faintly acid.	—	—	+	Few crystals.
Mch. 3	Cage.	Faintly acid.	—	—	+	Typical crystals.

Dog 80. Dec. 17-27. Animal is normal in every respect. The catheterized urine on this last day (Dec. 27) gave a very unsatisfactory Cammidge test. After standing 24 hours a few coarse, insoluble crystals came down, but after dissolving again by boiling and filtering, a different type of crystal was formed which dissolved readily. It would seem that a slight change in concentration or in rapidity of cooling had modified the type of crystal to such an extent as to modify its solubility, a point upon which Cammidge lays much emphasis.

Jan. 11-16. Animal is quite well, and is on a strict milk diet, about 750 cc. given daily.

Jan. 25. Animal weighs 20 lbs., and is in excellent health.

Feb. 24. Under ether anæsthesia 10 cc. of the hydrolytic products from the pneumonic lung described above (dog 76) were injected intraperitoneally. Repeated observations during this period before and after the injection gave a negative Cammidge test.

March 2. Under ether anæsthesia the animal was given intraperitoneally 17 cc. of the same solution obtained from the pneumonic lung. Before the injection the urine was negative, but repeated examinations after the injection gave positive Cammidge tests (see chart). The animal appeared pretty sick in the afternoon.

March 3. Animal is quite well and lively as usual.

March 17. Dog is quite well, weighs 21¾ lbs.

Nov. 8. Operation through right rectus: common bile duct doubly ligated and cut between ligatures.

Nov. 9. Bile pigments are present in the urine.

Nov. 10. Urine is high colored and contains a large amount of bile pigment.

JAUNDICE.

Dog 69. Fox Terrier, Female, Weight 13¼ lbs.
Nov. 8. *Ligation of Common Duct.*

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Nov. 10	Cage.	Acid.	—	—	+	
Nov. 12	Cage.	Acid.	Tr.	+	—	
Nov. 15	Cath.	Acid.	Tr.	—	—	

Nov. 14. Animal showed the clinical picture of obstructive jaundice, clay-colored stools, high colored urine, icteroid tint of sclerotics.

Nov. 16. Progressive loss of weight—12 lbs.

Nov. 26. Autopsy. All the tissues are deeply bile-stained. Otherwise the viscera are of slight interest. The pancreas is quite normal. The gall ducts and gall bladder are enormously dilated and the liver is a very deep greenish yellow color.

NORMAL DOGS.

Dog 78. Small mongrel, female, weight 13 lbs. This animal had been pregnant about 3 weeks previously and has nursed her pups for 2 weeks. At this time the breasts are decidedly prominent, and the animal is in excellent health.

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Dec. 12	Cage.	(?)	—	—	+	Many typical slender crystals.
Dec. 13	Cage.	Acid.	—	—	+	Small crystals.
Dec. 17	Cage.	Acid.	—	—	+	

Dec. 12-13. The animal is in perfect health. Indican was present in the urine, but no bile-pigments. The urine is decidedly concentrated and high colored.

Jan. 8. Animal is in good health and used for an experiment in metabolism.

Dog 93. Small mongrel, female, weight 12½ lbs. The animal is normal in every respect and appetite good.

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Feb. 22	Cath.	Acid.	—	—	+	Two types of crystals, one type very fine hair-like crystals in sheath form, the other considerably larger and more like the typical Cammidge crystals; both soluble in acid.
Feb. 23	Cath.	Acid.	—	—	+	

March 4. Animal is in perfect health and used for experiments in metabolism.

HUMAN CASES.

Blake: Autopsy 3298. This case was clinically one of acute pancreatitis following an operation for gall-stones.

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Nov. 18	Mixed.	Alk.	Tr.	—	+	Large amount of typical crystals.
Nov. 19	Mixed.	Acid.	(?)	—	++	
Nov. 20	Mixed.	Alk.	Tr.	—	+	Few crystals.

Autopsy Nov. 21. Anatomical Diagnosis: Icterus; chronic cholecystitis and cholangitis; operation wounds (choledochostomy); abscesses in pancreas and lesser omental cavity; acute pancreatitis with fat necroses; acute general peritonitis; acute gastritis and diphtheritic enteritis; subacute nephritis; bronchopneumonia and œdema of lungs; chronic splenic tumor.

The abscess cavity had caused digestion and disappearance of the greater part of the body of the pancreas, the main pancreatic duct, however, persisting with an intact lumen. The head and tail of the organ showed a subacute type of inflammation. Here the gland was hard, firm, enlarged and speckled over with little fat necroses.

Microscopical sections. The pancreas shows an extreme grade of chronic induration. There are many fat necroses; some of them are partly calcified, while others are quite recent, and surrounded by fragmented nuclei.

Stauffer. Autopsy 3320. Clinically this case was one of very acute leukæmia of two months duration. There was progressive anemia and slight increase in white blood cells from 8000 to 13,000. Differential counts showed from 50 to 70 per cent of large undifferentiated mononuclear cells.

Date.	Urine.	Reaction.	Alb.	Reducing bodies.	Cammidge test.	Remarks.
Dec. 27	Mixed.	Acid.	(?)	—	++	Beautiful needle-like crystals, easily soluble.
Dec. 29	Mixed.	Acid.	—	—	+	
Jan. 3	Mixed.	Acid.	(?)	+	—	

Jan. 3. Autopsy 3320. Anatomical Diagnosis: Leukæmia (myeloid); hyperplasia of bone-marrow and lymph glands; splenic tumor; anemia; fatty degeneration of myocardium and liver; pigmentation of liver, portal glands and testicles; disseminated ecchymoses; hemorrhagic bronchopneumonia and œdema of lungs; acute fibrinous pleurisy; subacute adhesive pericarditis.

The viscera showed the usual findings in this condition. The *pancreas* is of normal size and general appearance. The lobulation clean cut. Section shows no abnormality.

Microscopical section. The stroma is little increased in amount, but the gland elements are quite normal. This is practically a normal gland as regards acini, islands of Langerhans and collecting ducts.

Several other cases in the wards were examined but are not reported because of the lack of autopsy reports. One of the workers in this group who has tested his own urine repeatedly has found on many occasions a typical positive Cammidge test, yet he is a strong adult male with excellent past history and not the slightest evidence of any pancreatic disease.

General Discussion.

Work in this laboratory has convinced us that there are several sources of error in the method—test "C"—and that the personal interpretations of a given test may be various. We have endeavored to eliminate this personal factor by duplicate tests and by repeated examinations of crystals from a single specimen by various workers on the same or different days. Even when quite inconspicuous the sediment in any given tube should be examined under the microscope, for it may be very slight and yet contain typical crystals. The crystals vary in the most amazing degree in some experiments, and it is not unusual to find at least two distinct types of crystals, perhaps both insoluble or both readily soluble in acid or one readily soluble and the other resistant to the acid. In such cases it is easy to understand how one person could diagnose the test as positive and a less enthusiastic observer

as negative. Parallel tests on the same specimen of urine by different workers usually gave identical results, but sometimes there were some minor differences in the shape and solubility of the crystals. It was found that the crystals could be modified to a considerable degree by slight changes in concentration of the solution or rapidity of cooling. When it was further noted that the solubility of these same crystals could vary to a certain degree depending on their shape and size, it seemed certain that this might be a grave source of error. The solubility depends in part upon the delicacy of the crystals—the long slender blade forms being almost invariably soluble on contact with acid. Changing the salt content may modify the type of the crystals and certainly the amount. This may be of importance when a concentrated urine is being tested.

It seems pretty clear from various publications that different observers are dealing with different substances or combinations of substances. The melting point of the Cammidge crystals is given as all the way from 140° to 180°. It is difficult to obtain a mass of these crystals in pure form, free from salts, etc., but this factor alone cannot explain the great variations seen in the publications of various workers. Our observations have not been extensive on this point, but are of interest because both series of determinations were made by the same worker under the same conditions. The pure crystals were obtained from two different animals—dog 72—subacute pancreatitis and dog 61—slight pancreatic atrophy and induration. The crystals were purified by repeated recrystallizations and washings in distilled water until the type of crystal was constant and no amorphous material was present. The material was thoroughly dried and the melting point determined by repeated observations. Crystals from dog 72 melted at 153-154° C. but those from dog 61 melted at 172° C. We are not prepared to explain these observations, but give them for what they are worth. We have made no observations on crystals obtained from human cases, but Cammidge claims that the crystals from both sources are identical and melt sharply at a fixed temperature 178-80° C. We are unable to confirm his observations.

A review of our experiments on acute and chronic pancreatitis shows an uncertain state of affairs as far as the Cammidge test is concerned. We believe that the pathological lesions produced by injection of bile into the pancreatic duct more closely resemble those found in human cases than do the lesions which follow crushing or ligating the gland as done by other workers. Our experience shows that such an acute process, if not too severe, will heal rapidly, and result in a chronic diffuse pancreatitis similar in all respects to the condition found in some human cases. Our experiments confirm the observations of most workers that the Cammidge test is usually present in the acute stage of pancreatitis, but even here it is not constant (dog 81). In the healing stage of the pancreatitis the Cammidge reaction is more often absent than present, and in advanced chronic pancreatitis it may be consistently absent (dog 84).

The test is not infrequently positive in normal dogs and men or may be present at one time and absent at another. The chart (dog 80) is very instructive showing how the test may vary in the same animal from week to week while the dog is in perfect health. It was suspected that the diet might have some influence on the test, but we have no evidence for this view. Two healthy animals which were under observation for a considerable period were placed on a fixed diet for 10 days—one on milk alone (dog 80) the other on raw meat alone (dog 84). The one on a milk diet (about 750 cc daily) developed abundant reducing bodies (lactose) in the urine, but the Cammidge test was negative in both animals during the period of observation.

Chloroform poisoning in dogs offers an opportunity to study the urinary changes following an extensive injury to the liver—advanced central liver necrosis and fatty degeneration. The pathological lesion is almost invariably limited to the liver, but in a few cases one finds a few fat necroses and opacities in the pancreas. The pathology of the disease has been described fully in a previous communication (chloroform poisoning—Whipple and Sperry). In a typical case at the end of 36 hours after chloroform anæsthesia, the liver is found to show central necrosis involving perhaps two-fifths of every liver lobule. This area of necrosis is invaded rapidly by wandering cells which help in the solution and removal of the tissue. This change is effected in great part during the next 3-5 days. During this time the products of cell autolysis are being removed by the blood stream and probably excreted at least in part by the kidneys. During this period the Cammidge test is almost constantly positive and the crystals may occur in enormous amounts. So it seems just to assume that the liver necrosis accompanied by the solution and absorption of the dead liver cells and degenerated leucocytes is responsible for the presence of the substance in the urine giving abundant Cammidge crystals.

Similarly one is not surprised by the reports of quite positive Cammidge tests in cases of pneumonia and peritonitis where there is much cell destruction and solution, particularly in the late stages. Only a single case of pneumonia in a dog has come under our observation, and that animal gave a typical Cammidge reaction. Some of the consolidated lung tissue from this animal which was very rich in polymorphonuclear leucocytes was hydrolized with acid, neutralized, filtered and concentrated to a clear amber fluid. It was thought that this could be looked upon as a rough imitation of the cell autolysis *in vivo*. Intraperitoneal injection of this fluid caused the substance to appear in the urine which gives the Cammidge test. Similar experiments were tried using hydrolyzed dog's thymus and human lung with constant results. Some of the animals were poisoned slightly by the injection, and it might be argued that the poisoning had upset the animal's metabolism and was responsible for the reaction—not necessarily any given substance in the injected fluid. It would be difficult to disprove this but the hydrolytic products themselves will give the Cammidge test when in proper dilution.

The two human cases are reported because they illustrate

two widely differing conditions in which cell destruction is active and perhaps explains the Cammidge test which was typical in both. The first case showed a large abscess pocket full of pus which had caused solution of nearly one-half of the pancreas, subacute pancreatitis and general peritonitis by direct extension. The second case of acute leukæmia we may assume showed rapid production and destruction of white blood cells. However, it is important to remember that perfectly normal vigorous men may give a positive Cammidge test on some occasions.

Conclusions.

1. The Cammidge test is of little value in establishing a diagnosis of acute pancreatitis in dogs. If the test is negative, it is pretty strong evidence against an acute pancreatitis.

2. The Cammidge test is of even less value in the condition of chronic pancreatitis in dogs and may be consistently absent even in extreme grades of this disease.

3. A positive Cammidge test is not infrequent in normal dogs and men.

4. The Cammidge test is almost constantly present in chloroform poisoning in dogs—a condition in which there is extensive liver necrosis and cell autolysis.

5. The Cammidge test may be present in cases of pneumonia or in any condition where there is active cell destruction and autolysis.

6. The Cammidge test may be produced experimentally almost at will by intraperitoneal injections of hydrolytic cleavage products. These split products may be prepared by boiling pneumonic lung tissue (dog or man) or thymus for hours with dilute acid, neutralizing, filtering and concentrating to a clear fluid.

7. The melting point of the crystals varies under different conditions indicating that the substance or substances are not constant.

8. The method is open to various errors and too much depends upon the personal equation, particularly in the interpretation of the various crystals.

9. The method is time consuming, and the results do not seem to warrant the expenditure of the time and materials.

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NOTES ON NEW BOOKS.

Les Problèmes de la Vie. Essai d'une interprétation scientifique des phénomènes vitaux. Par DR. ERMANNO GIGLIO-TOS. IVe Partie. La variation et l'origine des espèces. (*Cagliari: Chez l'auteur, à l'université, 1910.*)

This is a book which should be read and studied in association with the preceding parts, in which the author deals with vital phenomena from a theoretic and ideal point of view. In this volume he studies "the actions which may modify more or less profoundly the normal and ideal course of the fundamental biological phenomenon, and determines as exactly as possible the value of these actions, and the consequences which may be drawn from them." It is a work for the advanced biologist, and its importance can only be fully appreciated by one trained in special lines of research. The writer is a professor of zoology and comparative physiology in the University of Cagliari.

The Diseases of Infancy and Childhood, Designed for the Use of Students and Practitioners of Medicine. By HENRY KOPLIK, M. D., etc. Third edition. Revised and enlarged. (*New York and Philadelphia: Lea & Febiger, 1910.*)

This book of 944 pages enjoys a well-merited popularity. The subject-matter is well arranged and on the whole the single chapters are rich in useful information. In his description of the methods of analysis of human milk, the author states that he utilized the method of Woodward for the determination of the proteids and found it satisfactory. The final step of this method involves the use of the centrifuge, reading there the volume of the precipitated proteid. As a rule such methods cannot be much relied upon for accuracy. We therefore should have liked to see the authors statement fortified by control analyses. Fortunately in this particular instance a far reaching accuracy is not necessary for practical purposes. In the chapter on Maternal Nursing the author states that he has found the mothers very anxious to perform this function, but the average mother to-day has not the physical development that fits her to nurse the child. To this statement propounded *ex cathedra* we must register our most serious exceptions. It appears to us that the fault is not to be found so much with the physical development of the mother as with the neglect with which the technique of nursing has been treated by the physicians, an objection from which this chapter is not free by any means. For instance the gradual change of the composition of the breast-milk during nursing, the fact that the infant takes the bulk of its food within the first minutes has not received sufficient attention. These factors frequently enter into consideration in the management of a case and in the collection of the milk for analysis. As usual the contraindications to maternal nursing are treated rather cavalierly while the possibilities of keeping the baby on the breast where the lactation is delayed or has become insufficient for some reason receive the scantest of attention. The dangers of milkstasis for the lactation should have been emphasized much more. The author relates that he has seen infants thriving in spite of suffering from repeated colic, while the milk showed quite a number of colostrum corpuscles. After certain hygienic hints were carried out by the mother these colostrum corpuscles disappeared from the milk, the colic abated and the infant returned to a normal condition. Very good; but is it not very much within the scope of a text-book to inform the student about these certain hints? With regard to the problem of the wet nurse it is stated: "In the first place it is not moral nor conducive to the future good of the race to ask a mother (the wet nurse) to put aside her own child and to deprive it of the breast for the sake of a strange child." There cannot be the slightest doubt that—as far as the physician is concerned—one baby is as good as another, but we fail to see the necessity of depriving the baby of the wet nurse of the breast. If a mother cannot or will not nurse her own baby it is best to provide a good wet nurse if possible. Any discussion of this question is impossible and under such conditions it is the duty of the physician to see to it that the baby of the wet nurse is not pushed aside. The artificial feeding of infants is treated in twenty-four pages. The author treats this subject in a conservative manner and his presentation is free from dogmatic statements. It may not be amiss giving a place to the very simple method described by Czerny and Keller among the more complicated methods. The following sentence is not clear: "The difficulty of calculating what is known as the calories necessary to the maintenance of nutrition and body weight—and by calories is meant the amount of albumin or proteids, fats, salts, and water mentioned above—is, that the physician cannot always have at his disposal a method by which these calculations can be made." In the determination of the caloric value of food the proteins, fats and carbohydrates enter in consideration, while the salt and the water do not.

The description of the allergic phenomena underlying the cutaneous tuberculin reaction is not clear. According to von Pirquet an organism infected with tuberculosis or having passed through such an infection possesses a certain antibody. This antibody reacts with the tuberculin and there results a toxic product, which is responsible for the reaction.

In the chapter on syphilis we miss any mention of the Wassermann-Bruck reaction.

Eleven pages are devoted to the diseases of the skin. We should like to see this section enlarged in a future edition and particularly the different tuberculous lesions of the skin may deserve a separate chapter here. The lesions due to rhus toxicodendron and their treatment should find a place here also.

Taking the book as a whole it is very serviceable and can be recommended strongly to the student as well as to the practitioner.

A System of Operative Surgery. By Various Authors. Edited by F. F. BURGHARD, M. S. (Lond.), F. R. C. S. (Eng.), etc. In Four Volumes. Vol. III. (*London: Henry Frowde and Hodder & Stoughton.*) *Oxford Medical Publications.*

This volume is divided into five Sections as follows:

Section I. Part 1. Operations for Tuberculous Disease of the Lymphatic Glands, by Harold J. Stiles. Part 2. Operations upon the Spleen, by B. G. S. Moynihan and Harold Upcolt. Part 3. Operations upon the Thyroid Gland, by James Berry.

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Section V. Part 1. Operations upon the Breast, by Harold J. Stiles. Part 2. Operations upon the Thoracic Wall and Its Contents, by Rickman J. Godlee.

The general excellence of this system will be best measured when it is complete, but like all systems this one suffers from an inequality in the value of the articles; and there is one special defect and that is a very incomplete index. To American students the work is of special interest in presenting the views of many of

the leading English operators and a comparison with prevalent American surgical methods and ideas is enlightening. A busy surgeon hardly has time to consult such a work as this, but he who has time to read will be glad to have this volume on his shelves for study and reference.

Précis du traitement des fractures par le massage et la mobilization. Par le Docteur JUST LUCAS-CHAMPIONNIÈRE. Un vol. in-16 de 268 pages. Prix: 3 fr. 50. G. Steinheil, éditeur, 2, rue Casimir-Delavigne, Paris.

To all students of surgery the author's name is well known, as one of the leading surgeons in Paris. He has written other works on the cure of hernia, and aseptic surgery and the present small volume is a résumé of a larger work on the treatment of fractures. Those who enjoy reading French and desire to know what this surgeon thinks of the value of massage and mobilization of fractures will be glad to have this book which they can easily slip into their pocket. The author's experience and opinions deserve study and consideration.

La Cure radicale de la hernie inguinales. Leçons professées à l'Hôtel-Dieu. Par le Docteur LUCAS-CHAMPIONNIÈRE. (*Paris: G. Steinheil, éditeur, 1909.*)

Few surgeons have written more than this author on hernia, and as its radical cure is one of constant interest to surgeons, his last (?) word on the subject will be gladly received. There is an operation for hernia which bears his name and in which he has supreme confidence, but as there seems to be no one operation which is always successful, so this one cannot be recommended for every case. This small volume of less than 200 pages is well illustrated and printed, and those who cannot read French will miss a distinct pleasure in being unable to study this work at first hand.

The Harvey Lectures, 1908-1909. (*Philadelphia and London: J. B. Lippincott Company, 1910.*)

All these lectures with the exception of one on "Heredity in Man" by C. B. Davenport have been published in different medical journals since they were delivered, but as a token of the good work being done by the Harvey Society of New York, under whose auspices they were given, it is pleasing to have them collected in a volume. The society may be congratulated on the success of their undertaking, and the selection of the lecturers has been most happy. These are not popular lectures but intended rather for doctors; only one of them—but one of the best—being of a popular quality. It is the lecture by Prof. Calmette of Lille on "Intestinal Infection and Immunity in Tuberculosis," a brief but clear exposition of the problem. The other papers are more difficult of comprehension except to students working along certain lines. There is another paper by His on Immunity and one by Anderson and Rosenau on Anaphylaxis, and there are four papers directly or closely connected with metabolism. The three lectures by Lusk, Falta and Leathes should be read together, as Lusk and Falta discuss Diabetes from the side of metabolism and therapy respectively, and Leathes analyzes the destruction of fats by the liver. MacCallum's paper is entitled simply "Fever" but it is essentially a study of its various causes. The remaining lectures are by Macallum and Davenport and both deal with problems of heredity but from absolutely unallied standpoints. It is a pity that the lectures are not printed exactly as they were delivered. There is but a brief and therefore a most unsatisfying sketch of Davenport's paper, and Calmette's is undoubtedly shorter, while Anderson's and Rosenau's is longer than when delivered. Otherwise there is no criticism to be found with the lectures which with their varying interests will appeal to various classes. They are all well worth reading—even Davenport's.

Emergencies of General Practice. By PERCY SARGENT, M. B., F. R. C. S., etc., and ALFRED E. RUSSELL, M. D., F. R. C. P., etc. Price, $5.50. (*London: Henry Frowde and Hodder & Stoughton, 1910.*) *Oxford Medical Publications.*

The authors have been to some pains to compile a work for which it is to be feared that there can be no wide demand, for the information contained in it should be ready to use in the brain of every student about to graduate in medicine. For the country practitioner to have such a volume to refer to from time to time may be serviceable, but the city practitioner will seldom have occasion to use it. It is difficult to know exactly how to define "emergency" and Sargent and Russell have stretched its real meaning liberally so as to include a large variety of conditions. There are chapters on wounds, hæmorrhage, burns, fracture, injuries to joints, acute infectious diseases, diseases and injuries of the chest, the abdomen, and the nervous system, etc. To those who enjoy a quiz compend and like to have information well condensed, this book can be recommended for it is well written and reliable.

Constipation and Allied Intestinal Disorders. By ARTHUR F. HERTZ, M. A., M. D., Oxon., M. R. C. P., etc. (*London: Henry Frowde and Hodder & Stoughton, 1909.*) *Oxford Medical Publications.*

One cannot help being impressed by the thoroughness with which the author has dealt with the various phases of his subject.

But perhaps the most distinguishing feature of the work is the skillful use he has made of bismuth in diagnosing the different abdominal conditions. Indeed, the work might well have been called a "Study in Bismuth." Nearly every form of constipation known has been subjected to the bismuth X-ray diagnosis, with the result that several interesting and highly instructive plates have been obtained—such as those shown on page 102.

It is unfortunate, though, that all the drawings and reproductions are schematic, because one is apt to get the impression that a little bismuth and an X-ray plate are all the requirements necessary to reveal any old form of intestinal sluggishness or incompetence. The reverse is, of course, true—it requires an experienced eye to interpret even a good plate after a bismuth meal.

Taking the book as a whole, we would consider it suitable rather for reference than as a text-book or a book for the busy practitioner. It is well arranged, the style is good and the literature given at the close of each chapter is both voluminous and up-to-date. In addition to this, the author adds an appendix to the book in which he tells of "The Administration of Bismuth Salts for the Skiagraphic Examination of the Alimentary Canal." This, of itself, should prove to be of great value to those who wish to use or are accustomed to use bismuth and the X-ray in abdominal conditions.

B. W. B.

International Clinics. Edited by HENRY W. CATTELL, M. D. Volume II. Twentieth Series. (*Philadelphia and London: J. B. Lippincott Company, 1910.*)

An unusual and amusing contribution to this volume is Curtin's account of "The Book-Plates of Physicians, with Remarks on the Physician's Leisure-Hour 'Hobbies.'" There are numerous illustrations many of which show that strange and common desire on the part of doctors to indicate their profession by some evidence of death—like a skull or skeleton. Walsh's paper on "The Progress of Medicine During the Past Twenty Years" is good reading, and in "The Spontaneous Cure of Cancer," by McConnell, are records of some most remarkable cases. This article should be read in connection with Sherrill's on "Some Remarks Concerning So-Called Inoperable Tumors, etc." There are other papers on various subjects also well worth reading.

Progressive Medicine. Edited by HOBART AMORY HARE, M. D., etc. Assisted by LEIGHTON F. APPLEMAN, M. D., etc. Volume II. June, 1910. (*Philadelphia and New York: Lea & Febiger, 1910.*)

In this volume the latest and most important contributions, as well as most recent views on hernia are reviewed by Coley; on surgery of the abdomen, exclusive of hernia, by Foote; on gynecology by Clark; on diseases of the blood, diathetic and metabolic diseases, diseases of the thyroid gland, nutrition, and the lymphatic system by Stengel; and on ophthalmology by Jackson. With the help of this work the general practitioner can keep himself well informed on the progress made in many branches. It is a pity that the editors do not pay more attention to systematizing the bibliography of the various chapters, the titles of various medical publications referred to should be abbreviated throughout in the same way, and references to volumes, pages, and dates should conform to one plan.

A Practical Treatise on Fractures and Dislocations. By LOUIS A. STIMSON, B. A., M. D., LL. D. (Yale), etc. Sixth Edition, Revised and Enlarged. Illustrated. (*New York and Philadelphia: Lea & Febiger, 1910.*)

This excellent work is so well known by the profession that it needs no fresh commendation. Dr. Stimson has added to its value by new studies of injuries to the small bones of the wrist and ankle, and fractures of the acetabulum, femur, and dislocation of the jaw. The book is so complete that almost every known fracture and dislocation is described in it, and no surgeon can afford to be without this classic.

Diseases of the Colon and Their Surgical Treatment. By P. LOCKHART MUMMERY, F. R. C. S., Eng., etc. Illustrated. Price, 10*s*. (*Bristol: John Wright & Sons, Ltd. London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd.*)

Diseases of the entire gastro-intestinal tract require much more careful study than they have yet received, and this small volume which is "founded upon the Essay which was awarded the Jacksonian Prize for 1909 by the Royal College of Surgeons," is an addition to the subject which will help many a student. It treats the diseases from both a medical and surgical standpoint, and while in no sense exhaustive the author has succeeded in bringing out clearly the salient features of the different conditions described. On diagnosis he has laid especial stress, which after all is the most essential feature to secure good treatment; he has also carefully considered the effect of adhesions, which is not always sufficiently present in the mind of an operator, so that as a result of poor technique the patients' condition may be worse after an operation than before it, simply due to their development. To constipation, which is a condition too often neglected by the physician through indifference, Mummery has also given full attention, as well as to other common troubles of the colon. As far as the author goes, the work is excellent, and the publishers may also be commended for their part.

Manual of Operative Surgery. By JOHN FAIRBAIRN BINNIE, A. M., C. M. (Aberdeen). Professor of Surgery, Kansas State University, Kansas City, etc. Volume II. Vascular System, Bones and Joints, Amputations. Fourth Edition, Revised and Enlarged with 550 Illustrations. (*Philadelphia: P. Blakiston's Son & Co., 1910.*)

In the preface the author says he has devoted an unusual proportion of the volume to a consideration of operations less frequently demanded, some of which are even still *sub judice.*

He states that the aim of this manual is particularly to give aid to the junior surgeon when he is brought face to face with the difficult or unusual in his practice.

The book is divided into 47 chapters and deals with the surgery of the Vascular system, Bones and Joints, Amputations, Tendons, and Dupuytren's Contracture. The chapter on Congenital Luxation of the Hip is written by G. G. Davis of Philadelphia.

The descriptions are necessarily brief, but convey the ideas admirably. The operative procedures are divided into steps, which are taken up in order.

There are a number of references scattered through the text and quotations from important papers.

The illustrations are good and the book is up-to-date. J. S. D.

Physiology and Pathology of the Semi-Circular Canal. Being an Excerpt of the Clinical Studies of Dr. Robert Barany with Notes and Addenda Gathered from the Vienna Clinics. By ADOLPH C. IBERSHOFF, M. D., and a Foreword by ROYAL S. COPELAND, M. D. Price, $1. (*New York: Paul B. Hueber, 1910.*)

This is a book of comparatively few pages. It will serve, however, to place before the reader in available form some more recent clinical investigations of the inner ear which have, as yet, not found their way into the regular text-books. Several pages are devoted to the subject arbitrarily entitled "Caloric Nystagmus" and it would seem that a perusal of these pages should convince most otologists that these tests spoken of should be more generally adopted in the routine examination of many ear patients and if it does this the little book will serve the purpose for which it has been gotten up. B. B. B., JR.

Errors of Refraction and Their Treatment. A Clinical Pocket-Book for Practitioners and Students. By CHARLES BLAIR, M. D., F. R. C. S. Second Edition. Price, 2*s*. 6*p*. (*Bristol: John Wright & Sons, Ltd. London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd., 1910.*)

This is a very small book in which the most elementary principles regarding the refraction of the human eye are set forth. It is rather difficult to see for what class of readers this book is designed as all the facts therein stated are covered in one of the reliable text-books on the eye, which the medical student can readily get at, and the general reader who might be ambitious to learn something of this can find all these facts in any high-school physics or encyclopedia. The book is too elementary to be of value to advanced students of ophthalmology. B. B. B., JR.

Education in Sexual Physiology and Hygiene. A Physician's Message. By PHILIP ZENNER, Professor of Neurology in the Medical Department of the University of Cincinnati. Price, $1. (*Cincinnati: The Robert Clarke Company, 1910.*)

For those who have to teach these subjects this book may prove helpful, but is too brief to be more than suggestive along certain lines.

Diseases of the Eye. A Handbook of Ophthalmic Practice for Students and Practitioners. By G. C. DE SCHWEINITZ, A. M., M. D., etc. Illustrated. Sixth Edition. Thoroughly Revised. Price, $5. (*Philadelphia and London: W. B. Saunders Company, 1910.*)

We have always looked with favor on Dr. de Schweinitz's well-known book on the Diseases of the Eye. This is the sixth edition, which shows that it has met with merited approval from medical practitioners and students. But few changes are noted in the present edition, and we have no doubt but that it will continue to be the means by which many senior medical students of forthcoming years will acquire accurate and reliable information concerning the Diseases of the Eye. As a text-book for medical students the book has only one fault, prevalent throughout, and that is that

in regard to the therapeutic measures, the author is too liberal in his suggestions and not definite and dogmatic enough in his recommendations. However, the minor faults are few, and the spirit of conservatism in which it is written—for the author rides no hobbies of his own nor has he been carried away by those of others—commends it to all those interested in the study of eye diseases.

B. B. B., Jr.

Transactions of National Conference on Pellagra, Held under Auspices of South Carolina State Board of Health at State Hospital for the Insane, Columbia, S. C., November 3 and 4, 1909. (*Columbia, S. C.: The State Co., Printers, 1910.*)

As the first collective report on pellagra in this country, these transactions are most important, and henceforth the recognition and diagnosis of the disease will be much easier for the general practitioner; and soon it will be possible to make a fair estimate as to its prevalence in the southern States. It is most necessary that individual cases should be recognized as early as possible, since only in the first stages does the disease seem to be curable, and its chronicity and later symptoms are much to be dreaded. Now that the medical profession is beginning to be aroused as to its prevalence, we may hope that its spread may be limited and that if necessary the U. S. government will take such steps as lies in its power to control it. In this report there are many admirable papers dealing with the clinical side of pellagra, and the interest of the conference was much enhanced by the presence of, and the reading of papers by foreign medical men who had had special opportunities to study this disease. The South Carolina State Board of Health is to be most heartily congratulated on the success of its meeting, and the publication of this volume.

Light Therapeutics. By J. H. Kellogg, M. D. (*Battle Creek, Mich.: The Good Health Publishing Co., 1910.*)

"As a practical manual for the clinical use of the electric-light bath in its various forms," the object of the author in writing this manual seems to be satisfactorily reached. It is divided into eight chapters on 1, The physics of light; 2, the physiological effects of light; 3, the therapeutics of light; 4, effects of heat and cold and their use in therapeutic combination; 5, technique of light applications; 6, phototherapy plus hydrotherapy; 7, clinical phototherapy; and 8, phototherapeutic appliances. The value of light in its various forms as a therapeutic agent still demands much study, and not all the benefits accorded it by its advocates can be substantiated, but none the less it is useful in certain cases, and this book will help students to learn how it may be best used.

Medical Gynecology. By Samuel Wyllis Bandler, M. D., etc. Second Revised Edition. Illustrated. Price, $5. (*Philadelphia and London: W. B. Saunders Company, 1909.*)

In the preface to the first edition the writer states that the book has been prepared as a result of frequent inquiries for a work dealing with the non-operative side of gynecology. The various topics have been viewed from the standpoints of the symptoms, the disease, the bimanual and microscopic findings, and the general, physical and nervous state. In order to do this repetition and reiteration are necessary but these emphasize the important points and make each section complete in itself, thus diminishing as much as possible the necessity of referring to other sections except for more complete elucidation. He has endeavored to show the relation which pelvic abnormalities really bear to the physical and mental state of the female in order that we may deal intelligently with the gynecologic diseases and not confine our diagnosis and therapeutic methods to the pelvis. The writer states that he has consulted particularly the writings of Kisch (puberty); Joseph (syphilis and gonorrhœa); Bumm, Wertheim and Ringer (gonorrhœa); Oskar Frankl (electricity and hydrotherapy) and especially Winter for much that has appeared in the book.

In the preface to this the second edition he states that the chapters on electricity and hydrotherapy have been enlarged and various other additions have been made to the book as a whole.

The first section is devoted to gynecological examination; the next to a description of the various methods used in the medical treatment of gynecological conditions. This is followed by a very important feature of the book, i. e., the study of the principal symptoms arising from gynecological diseases by stating the causes of each and methods of diagnosis and treatment. The chapters on associated nervous conditions, constipation and gonorrhœa are very thorough and practical. The various gynecological diseases are presented by describing the pathological conditions present, its sy[illegible]ms, diagnosis, and the treatment indicated.

The work is particul[illegible] the general practitioner because it presents the su[illegible]curs in practice, i. e., from the standpoint of the [illegible]e and not from the consideration of the pelvis al[illegible]

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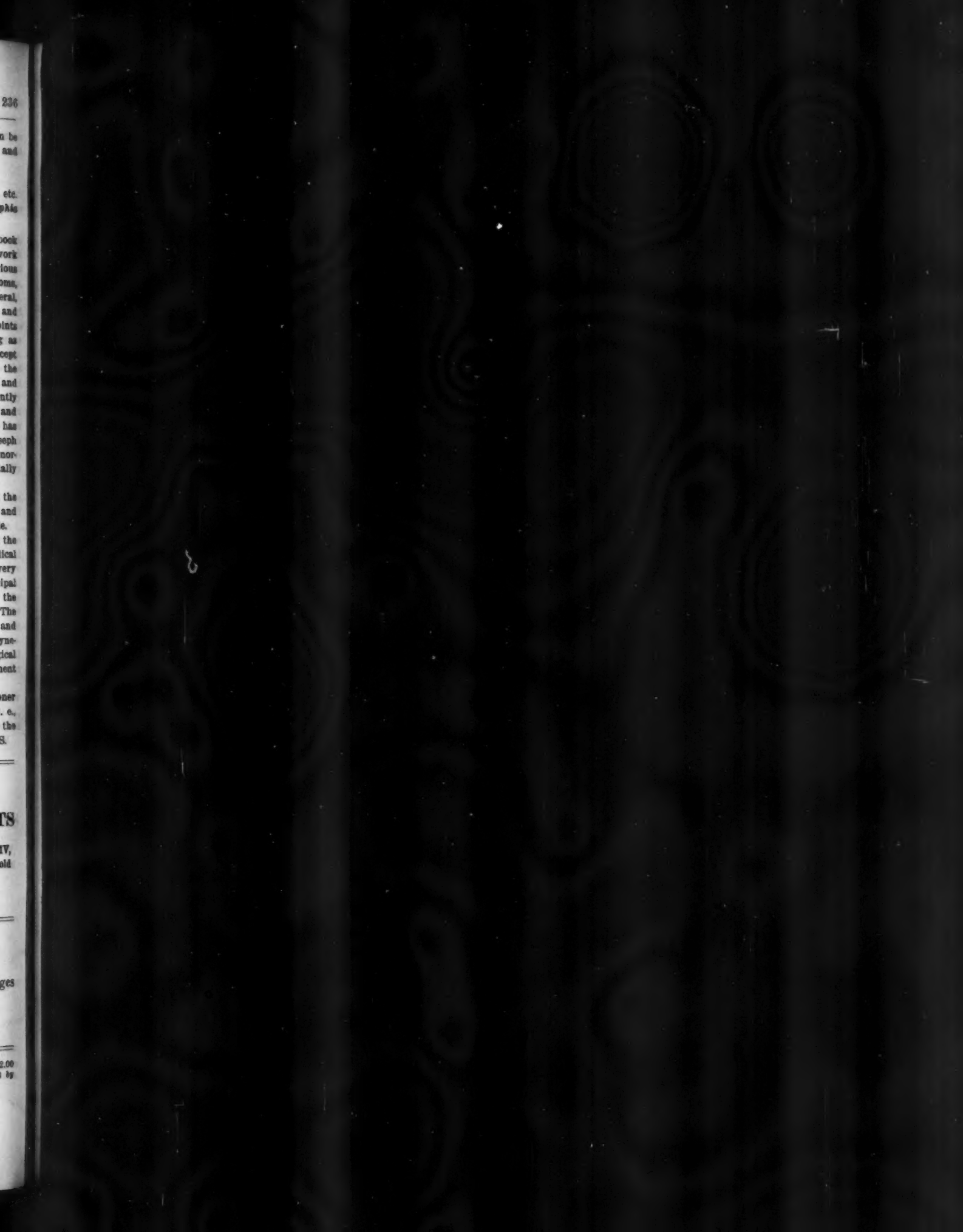
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